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REPORT
OF
EXPLORATIONS
ACROSS THE
GREAT BASIN OF THE TERRITORY OF UTAH
FOR A
DIRECT WAGON-ROUTE FROM CAMP FLOYD TO GENOA, IN CARSON VALLEY,
IN 1859,

BY

CAPTAIN J. H. SIMPSON,
CORPS OF TOPOGRAPHICAL ENGINEERS, U. S. ARMY,
[NOW COLONEL OF ENGINEERS, BVT. BRIG. GEN., U. S. A.]

MADE

BY AUTHORITY OF THE SECRETARY OF WAR, AND UNDER INSTRUCTIONS FROM BVT. BRIG. GEN. A. S. JOHNSTON,
U. S. ARMY, COMMANDING THE DEPARTMENT OF UTAH.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1876.

F826 .U59

OFFICE OF THE CHIEF OF ENGINEERS,
Washington, D. C., *May* 17, 1875.

SIR: I have the honor to submit herewith a report by Captain (now Colonel and Brevet Brigadier-General) James H. Simpson, of his Explorations in the Great Basin of Utah in 1859, with a view of recommending that it be printed.

It contains much valuable information concerning the geography, topography, geology, meteorology, zoölogy, ethnology, history, and statistics of the country through which Captain Simpson explored a route from Camp Floyd, in the vicinity of Salt Lake City, to Carson City, Nev., which was afterward known as "Simpson's route."

This was an *original* route, *i. e.*, it had not been before explored, and as it shortened the distance from the East to San Francisco more than two hundred and fifty (250) miles, it was at once adopted by the overland mail, the pony-express and the telegraph.

The report also contains a description of an exploration for a wagon-road from the valley of the Timpanogos River, over the Uintah Mountains, to the Green River, and a translation from the Spanish of the narrative of Padre Escalante of his remarkable journey from Santa Fé to Utah Lake and return by way of Oraybe (one of the villages of the Moquis), Zuñi, and Acoma, in 1776–'77.

A large part of the country traversed by Captain Simpson has not been described by any subsequent explorer; and as his report was not printed, owing to the late war coming on about the time it was completed, the valuable information it contains is not available for the use of the Government or the public.

I would therefore respectfully recommend that it be printed at the Government Printing-Office, and that 1,500 copies be furnished on the usual requisition.

By direction of Brigadier-General Humphreys, and in his absence.

Very respectfully, your obedient servant,

GEORGE H. ELLIOT,
Major of Engineers.

Hon. WM. W. BELKNAP,
Secretary of War.

Approved:
By order of the Secretary of War.

H. T. CROSBY,
Chief Clerk.

WAR DEPARTMENT, *May* 19, 1875.

Reclas. MVP. 11-27-37

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ERRATA.

Page 6, line 5, for 5 read 385.

Page 29, bottom line, for *Rivers* read *River*.

Page 30, line 12, for *Lynogris* read *Linosyris*.

Page 31, line 8, for *Lynogris* read *Linosyris*.

Page 31, line 14, for *Epledra peduculata* read *Ephedra pedunculata*.

Page 42, line 43, for *Sangrede Christs* read *Sangre de Cristo*.

Page 45, line 25, for *lynosyris* read *linosyris*.

Page 52, line 37, for *aremost* read *are most*.

Page 55, number of page, for 5 read 55.

Page 69, line 18, for *Greator* read *Creator*.

Page 76, line 38, for *reveillé* read *reveille*.

Page 84, line 21, for *morphôsedst, ratified* read *morphosed, stratified*.

Page 95, line 19, for *Putman* read *Putnam*.

Page 110, line 36, for *Won-a-ho-pe* read *Won-a-ho-no-pe*.

Page 118, line 10, for *amp* read *Camp*.

Page 141, line 15, for *would add* read *I would add*.

Page 159, lines 2 and 6, for *Putman* read *Putnam*.

Page 162, line 5, for *Putman* read *Putnam*.

Page 163, line 15, for *Putman* read *Putnam*.

Page 164, in table, line 25, for *akaline* read *alkaline*.

Page 171, in table, line 8, for *hand* read *had*.

Page 181, line 29, for *rec ords* read *records*.

Page 192, in table, for *Fahredheit* read *Fahrenheit*.

Page 197, line 31, for *recurs* read *occurs*.

Page 211, in table, line 6, for *Bar River* read *Bear River*.

Page 234, lines 4, 5, and 21, for *Zuni* read *Zuñi*.

Page 248, line 2, for *prevalance* read *prevalence*.

Page 281, line 2, for *fragillis* read *fragilis*.

Page 309, line 9, for *cious* read *ceous*.

Page 321, line 26, for *Artimisia* read *Artemisia*.

Page 332, line 13, for *ashe* read *ashes*.

Page 414, line 34, for *thymology* read *etymology*.

Page 439, line 40, for *Bigelw* read *Bigelow*.

Page 498, line 41, first column, for *purpurens* read *purpureus*.

Page 499, line 3, second column, for 429 read 423; line 26, for *Phractocephalis* read *Phractocephalus;* line 6, from below, for *Potamocattus* read *Potamocottus*.

Page 501, line 31, first column, for *Escalanté* read *Escalante;* line 24, from below, second column, strike out *Kern, R* . . . . 483.

Page 502, line 26, for *Ute, Pete,* read *Ute Pete*.

Page 504, line 16, first column, for 294 read 295; line 18, for *Wan-a-ho-nupe* read *Won-a-ho-no-pe*.

Page 506, line 3, second column, for 996 read 296; line 26, second column, for 239 9, 251 read 239, 249, 251.

Page 507, line 7, first column, for *Bacevellia* read *Bakevellia;* line 20, first column, for *Campeloma* read *Campelona;* line 3, from bottom, for *Ventricosa* read *ventricosa;* line 9, from bottom, second column, for *Myatellinordes* read *Mya tellinoides*.

Page 508, line 20, first column, for *Phillophora* read *Phyllopora;* line 3, second column, for *Mensebachianus* read *Meusebachianus*.

Page 509, line 13, first column, for 371 read 271.

Page 510, line 27, first column, for *To-si-withes* read *To-si-witches;* line 29, first column, for 460 read 459; line 7, second column, for *Boupland* read *Bonpland;* line 19, from bottom, for *Utah* 3, 6 . . . read *Utah* 4, 6 . . .

Page 511, line 14, first column, for 121 read 120; line 13, from bottom, first column, for 272 read 262.

Page 513, top line, second column, for 254, 25 read 254, 257; line 4, second column, for *attitude* read *altitude*.

Page 516, between lines 15 and 16, first column, insert *Kern* . . . . 483; line 27, second column, for *Won-a-ho-un-pe* read *Won-a-ho-no-pe*.

Page 518, line 9, first column, for *Thornburg* read *Thornberg;* line 20, second column, for 184, 189, etc., read 142, 184, 189, etc.

LETTER OF TRANSMITTAL.

WASHINGTON, *February* 5, 1861.

SIR: Under date of December 28, 1858, I had the honor to submit to the headquarters of the Department of Utah a map and report of my explorations and opening, under instructions from Bvt. Brig. Gen. A. S. Johnston, commanding the department, of a new wagon-route from Camp Floyd to Fort Bridger, Utah, by the way of Timpanogos River Cañon and White Clay Creek, and of my explorations west of Camp Floyd, as far as Short Cut Pass, preparatory to more extended explorations during the ensuing year for a direct wagon-route from that post to Carson Valley.*

I have now the honor to submit a report and map of my explorations and opening, in 1859, of two new wagon-routes across the Great Basin of Utah, from Camp Floyd to Carson Valley, by means of which the traveling distance from Camp Floyd to San Francisco, when compared with the old Humboldt River route, has been shortened, in the case of my more northern route, 283 miles, and in the case of my more southern route, 254 miles.

The orders of the Hon. John B. Floyd, Secretary of War, sanctioning the explorations, and the instructions of General Johnston, commanding the Department of Utah, directing the movement, will be found inserted in their proper place in the sequel.

The report will be found also to include the exploration, by direction of General Johnston, of a new pass from the valley of the Timpanogos River over the Uintah range of mountains into the Green River Valley, by means of which, it is believed, a wagon-route can be obtained thence to Denver City, in Kansas, and thus, by this route, in connection with my route across the Great Basin, a more direct route be obtained across the continent to San Francisco than any which at the present time exists.

The above are the most notable results of the expedition, but embraced in the report will be found information respecting the history, geography, topography, geology, meteorology, botany, zoölogy, ethnology, and statistics of the country traversed, which will not be without interest, as I trust, to the scientific as well as popular mind.

All these subjects are indicated in the Table of Contents, and under each head, in the report, will be found presented the discussions, descriptions, pictorial sketches, diagrams, and tables necessary to an elucidation and comprehension of the various topics growing out of the explorations.

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* This report forms Senate Ex. Doc. No. 40, 35th Cong., 2d Sess.

To my assistants, Lieuts. J. L. Kirby Smith and H. S. Putnam, of the Corps of Topographical Engineers; Mr. Henry Engelmann, geologist, meteorologist, and botanical collector; Mr. Charles S. McCarthy, taxidermist; Messrs. Edward Iagiello and William Lee, chronometer-keepers and meteorological assistants; and Mr. H. V. A. Von Beckh, artist, I hereby tender my thankful acknowledgments for faithful and efficient services rendered. The work performed by each will appear generally in the sequel, to which I refer for proof of the useful character and merit of their respective labors.

Lieutenants Smith and Putnam having, under my instructions, had an opportunity to practice for more than a month with the sextant, astronomical transit, unifilar magnetometer, and dip-circle, at Fort Leavenworth, before the Utah forces destined for Utah in the spring of 1858 took up the line of march for that Territory, and practicing with these instruments again on the march to Utah, they became so dexterous in their use as to make it unnecessary for me to have anything more than a general supervision over their observations subsequently across the Great Basin. To Lieutenant Smith, therefore, were intrusted the daily observations with the sextant for latitude and longitude, and to Lieutenant Putnam the occasional observations with the transit of moon and moon-culminating stars for longitude, and with the magnetometer and inclinometer, or dip-circle, for the intensity, declination, and dip of the magnetic needle.

In the "lunars" for longitude both would assist me, three sextants being used, they taking the altitude and I the angular distance, and all at the same instant of time. The other duties performed by these gentlemen will appear noted in the mention made in the journal of the organization at Camp Floyd of the expedition.

The very valuable contributions to my report by Mr. Henry Engelmann, in respect to the geology and meteorology, and by Mr. F. B. Meek, of the paleontology of the country, from Fort Leavenworth to the Sierra Nevada, and especially of that hitherto *terra incognita* in these respects, the Great Basin of Utah, I feel assured, will be readily acknowledged by all who take an interest in such subjects.

To Mr. Von Beckh I am indebted for the original sketches of scenery, and to Mr. John J. Young, of this city, for the very handsome manner in which they have been elaborated and perfected in the office for my report. I carried out with me a photographic apparatus, carefully supplied with the necessary chemicals by Mr. E. Anthony, of New York, and a couple of gentlemen accompanied me as photographers; but although they took a large number of views, some of which have been the originals from which a few accompanying my journals have been derived, yet, as a general thing, the project proved a failure. Indeed, I am informed that in several of the Government expeditions a photographic apparatus has been an accompaniment, and that in every instance, and even with operators of undoubted skill, the enterprise has been attended with failure. The cause lies in some degree in the difficulty, in the field, at short notice, of having the preparations perfect enough to insure good pictures, but chiefly in the fact that the camera is not adapted to distant scenery. For objects very close at hand, which of course correspondingly contracts the field of vision, and for single portraits of persons and small groups, it does very well; but as, on exploring expeditions, the chief *desideratum* is to daguerreotype extensive mountain-chains and other notable objects having considerable extent, the camera has to be correspondingly distant to take in the whole field, and the consequence is a want of sharpness of outline, and in many instances, on account of the focal distance not being the same for every object within the field of view, a blurred effect, as well as distortion of parts. In my judgment, the camera is not adapted to explorations in the field, and a good artist, who can sketch readily and accurately, is much to be preferred.

The contributions of Dr. George Engelmann upon the botany, Professor Spencer F. Baird on the ornithology, and of Mr. Theodore Gill on the ichthyology of the country traversed by the expedition, will also command attention, on account of the well-earned reputation of these gentlemen in their several special branches of scientific inquiry.

I must also draw attention to the contribution of Dr. Garland Hurt, in respect to the statistics and resources of Eastern Utah and the history and present condition of the Indian tribes inhabiting the Territory of Utah. The residence of this gentleman for several years in Utah as Indian agent, and his well-known intelligence and probity, give his statements a value which I am pleased here to acknowledge.

I must also express my thanks to Maj. Frederick Dodge, the General Government agent of the Washoe and Pi-Ute Indians, for information in relation to these Indians and the vocabularies of their languages, to be found appended to my report. The courteous treatment of my party by this gentleman on our arrival at Genoa, in Carson Valley, and afterward, was a cordial which can never be forgotten.

I also present my grateful acknowledgments to Mr. Edward M. Kern for his very valuable journal of his exploration of the Humboldt River, Carson Lake, and Owen's River and Lake in 1845, under Capt. John C. Frémont, Corps Topographical Engineers, now for the first time given to the public. The fact that this exploration under the authority of the War Department was the original source of the information and maps which we have of this particular portion of our country, gives it a peculiar value which all must acknowledge.

I would also draw attention to the map, synopsis, and extracts from the diary of Father Escalante's journey from Santa Fé to Utah Lake, and thence back to Santa Fé, by way of the Moqui country and the Indian *pueblos* of Zuñi and Acoma, in 1776–'77, by Mr. Philip Harry, of the Bureau of Topographical Engineers. Mr. Harry, at my solicitation, has done good service in the cause of geographical history, in translating the manuscript of this Spanish Franciscan monk, and now for the first time presenting extracts from it to the public, with a sketch plotted by him from this father's notes. The manuscript was kindly placed at my disposal for the purpose stated by Col. Peter Force, of this city, whose well-stocked library has before been drawn upon by officers of our corps for information in relation to the early history of our country. In the introduction to my report, it will be noticed that, before giving a general description of the physical characteristics of the Great Basin, I have gone fully into the history of all the explorations that have been made in it from the time of Escalante to the present period, which I trust will not prove unacceptable to all who take an interest in such researches.

I must also express my acknowledgments of cheerful service rendered by my assistant in the office, Lieut. Charles R. Collins, Corps Topographical Engineers, and Mr. J. R. P. Mechlin, of this city, in the aid they have given in the computation of scientific data and the draughting of the maps and profiles which accompany my report.

I should also fail in my obligations did I not bring to the notice of the War Department the very valuable assistance I received in the prosecution of my duties in the field from Lieut. Alexander Murry, Tenth Infantry, the commander of the escort accompanying the expedition. Lieutenant Murry is an officer of great energy, and zealous in the promotion of the best interests of the service; and it is a gratification to me to present him thus honorably to the consideration of the Government.

I have the honor to be, sir, very respectfully, your obedient servant,

J. H. SIMPSON,
Captain Corps Topographical Engineers, United States Army.

Col. J. J. ABERT,
Chief Corps Topographical Engineers.

EXPLORATIONS ACROSS THE GREAT BASIN OF UTAH.

INTRODUCTION

TO

REPORT AND JOURNAL.

INTRODUCTION.

History of the Explorations within the Great Basin of the Territory of Utah, from the time of Father Escalante, in 1776, to the present period, and a general description of the country.

The country known since the date of the explorations of Frémont, in 1843 and 1844, and by his appellation, as the Great Basin, has been, since the days of Fathers Sylvester Velez Escalante, and Francisco Atanacio Dominguez, in 1776, one of great interest.[a] This interest has grown out of the circumstance of its reported inaccessibility from extended deserts, its occupancy by Indians of an exceedingly low type, and the laudable curiosity, which prevails in the minds of men, to know the physical characteristics of a country which has so long remained a *terra incognita.*

This Great Basin has a triangular shape, nearly that of a right-angled triangle, the mountains to the north of the Humboldt River and of Great Salt Lake constituting the northern limit or border, and forming one leg of the triangle; the Sierra Nevada, or western limit, the other equal leg; and the Wahsatch range at the eastern, and (in continuation) the short mountain ranges and plateau country to the north of and not far distant from the Santa Fé and Los Angeles caravan or Spanish trail route to the southeast, the hypothenuse. These limits are embraced approximately within the 111th and 120th degrees of west longitude from Greenwich, and the 34th and 43d of north latitude, or within a limit of nine degrees of longitude and nine of latitude.

The earliest records we have of any examination of any portion of this Basin is derived from the journal of Father Escalante, descriptive of the travels of himself and party in 1776–'77, from Santa Fé to Lake Utah (by him called *Laguna de nuestra Señora de la merced de Timpanogotyes*, and also Lake Timpanogo), and thence to Oraybe, one of the villages of the *Moquis*, and back to Santa Fé. A manuscript of

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(*a*) Humboldt, in his "New Spain," translated by John Black, vol. 1, second edition, London, 1814, chap. II, p. 22, says: "These regions," referring to those between the Colorado and Lake Timpanogos (Utah Lake), "abounding in rock-salt, were examined in 1777 by two travelers, full of zeal and intrepidity, monks of the order of Saint Francis, Father Escalante and Father Antonio Velez." According to the manuscript narrative of these travels by Father Escalante, referred to subsequently in this report, and which I have consulted, I find that Friar Francisco Atanacio Dominguez, and not Velez, was associated with Escalante in these explorations, and that no such person as Velez accompanied the expedition. It is something singular, however, that Escalante's name was Silvester *Velez* Escalante. Can it be that Humboldt has fallen into the error of making two distinct persons out of this father's name, and of omitting that of Dominguez altogether? Or did a monk by name Antonio Velez explore this same region separately from the others and in the same year? I notice, also, that Humboldt dates Escalante's journey A. D. 1777. The manuscript shows that it was commenced July 29, 1776, and terminated in January, 1777.

this journey in the Spanish language is to be found in the rare and valuable library of Col. Peter Force, city of Washington, to which, agreeably to his well-known liberality, I have had ready access, and from which has been extracted for this report the valuable summary to be found, marked Appendix R, and for which I am indebted to the zealous co-operation of Mr. Philip Harry of the Bureau of Topographical Engineers. There will also be found in Mr. Harry's paper an extract from the manuscript, descriptive of Lake Utah and its valley, which Escalante explored as far north, doubtless, as the Timpanogos River (by him called the Rio San Antonio de Padua), and an allusion to the outlet of Lake Utah into a large body of salt water farther north, without question Great Salt Lake.

The destination of Escalante, his journal shows, was Monterey, on the Pacific coast; but being forced, doubtless by the desert immediately west of Lake Utah, to take the so-called southern or Los Angeles route, which Bonneville's party in 1834 and Frémont in 1844 followed, and finding that, while making a great deal of southing, he had made but little progress toward Monterey, his provisions giving out, and he fearing the approach of winter, with some difficulty he prevailed upon his party to abandon the idea of reaching Monterey, and to return to Santa Fé by the way of the villages of the Moquis and of Zuñi. (See the map of his route, Plate I, Appendix R.)

The next authentic record which shows that any portion of the Great Basin system was explored at an early date is to be found on the map entitled *Appendiente al Diario que formo el P. F. Pedro Font del Viaye que hizo á Monterey y Puerto de San Francisco, y del Viaye que hizo el P. Garces al Moqui,* "*P. F. Petrus Font fecit Tubutana anno* 1777;" which may be freely translated as follows: "A supplement to the diary of Father F. Pedro Font's journey to Monterey and San Francisco, and of Father Garces's to Moqui, executed by P. F. Petrus Font, at Tubutana, in the year 1777."[b]

According to this map, it appears that Father Garces traveled as early as 1777 (Humboldt says in 1773)[c] from the mission of San Gabriel, near the Pacific coast, in California, to Oraybe, one of the villages of the Moquis, and that his route was along the Rio de los Matires (evidently, from its position, the Mojave). Frémont and others supposed that the Mojave was a tributary of the Colorado, and therefore did not belong to the Great Basin system; but this idea was exploded by Lieutenant William-

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(*b*) A copy of this map is in the Bureau of Topographical Engineers, it having been furnished by Capt. E. O. C. Ord, Third Artillery, from an original one in the archives of California, and is quite interesting as showing the large number of Spanish settlements in Middle Sonora at the time of the travels of Fathers Font and Garces, and the exact routes explored by them.

According to Humboldt, Father Garces was the principal personage in these explorations, and to Father Font were intrusted the observations for latitude. Greenhow, in his Oregon and California, 4th ed., p. 114, speaking of the journals of Friars Escalante and Dominguez, and of Friars Garces and Font, says, "They are still preserved in manuscript in Mexico, where they have been consulted by Humboldt and other travelers, but they are, from all accounts, of no value." In regard to the journal of Escalante, Mr. Greenhow's criticism is unjust, for not only is this journal written in a plain, unpretending, direct manner, but it abounds in excellent and apparently just observations and facts; and it is wonderful that the courses and distances given by him from Utah Lake back to Santa Fé, by way of Oraybe and Zuñi, should plot so correctly, and should agree so well as they do with our present maps. And in regard to the journal of Friars Garces and Font, Humboldt, in speaking of the *Chronica* from which he derives his information respecting the travels of these monks, expressly states that "it forms a large folio volume of 600 pages, and is well-deserving of an extract being made from it." He goes on to say: "It contains very accurate geographical notions as to the Indian tribes inhabiting California, Sonora, the Moqui, Nabojoa, and the banks of the Gila." (See note, Humboldt's New Spain, vol. II, p. 253.)

(*c*) See his New Spain, vol. II, page 268.

son, Topographical Engineers, in 1853,[d] and afterward by Lieutenant Parke, Topographical Engineers, in 1855,[e] both of whom fully determined that this stream sank, and that intervening it and the Colorado was a ridge which separated these waters.

In this connection, it may be interesting to observe that Humboldt, speaking of the delay on the part of the Spaniards, notwithstanding their enterprising spirit, in opening communications between New Mexico and California, holds the following language:

"The letter post still (at the date of his researches in 1803–'04) goes from this port (San Diego) along the northwest coast to San Francisco. This last establishment, the most northern of all the Spanish possessions of the new continent, is almost under the same parallel with the small town of Taos, in New Mexico. It is not more than 300 leagues distant from it, and though Father Escalante, in his apostolical excursions in 1777, advanced along the western bank of the river Zaguananas toward the mountains *de los Guacaros*, no traveler has yet come from New Mexico to the coast of New California. This fact must appear remarkable to those who know, from the history of the conquest of America, the spirit of enterprise and the wonderful courage with which the Spaniards were animated in the sixteenth century. Hernan Cortez landed for the first time on the coast of Mexico, in the district of Chalchinhcuecan, in 1519, and in the space of four years had already constructed vessels on the coast of the South Sea, at Zacatula and Tehuantepec.

"In 1537, Alvar Nuñez Cabeza de Vaca appeared, with two of his companions, worn out with fatigue, naked, and covered with wounds, on the coast of Caliacan, opposite the peninsula of California. He had landed with Panfilo Narvaez in Florida, and after two years' excursions, wandering over all Louisiana and the northern part of Mexico, he arrived at the shore of the great ocean in Sonora. This space which Nuñez went over is almost as great as that of the route followed by Captain Lewis from the banks of the Mississippi to Nootka and the mouth of the river Columbia.[f] When we consider the bold undertakings of the first Spanish conquerors in Mexico, Peru, and on the Amazon River, we are astonished to find that for two centuries the same nation could not find a road by land in New Spain from Taos to the port of Monterey."[g]

Humboldt here was undoubtedly in error. The map of Father Font, before referred to, shows that as early as 1777 Father Garces traveled from the mission of San Gabriel, near the Pacific coast, to Oraybe, one of the villages of the Moquis, in New Mexico, and the inscription on the rock "*El Moro*," near Zuñi, in New Mexico, an account and transcript of which I give in my "Journal of a military reconnaissance from Santa Fé to the Navajo country in 1849,"[h] show that there was as early as 1716 a communication opened with the Moquis from Santa Fé. The inscription is as follows: "In the year 1716, upon the 26th day of August, passed by this place

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(*d*) Pacific Railroad Reports, vol. V, pages 33 and 34.

(*e*) Pacific Railroad Reports, vol. VII, page 3.

(*f*) "This wonderful journey of Captain Lewis was undertaken under the auspices of Mr. Jefferson, who by this important service rendered to science has added new claims on the gratitude of the savans of all nations." (Note by Humboldt.)

(*g*) Humboldt's New Spain, vol. ii, pp. 289–290.

(*h*) See Sen. Ex. Doc. 64, 31st Cong., 1 sess., p. 123, or same published by Lippincott, Grambo & Co., 1852, p. 104.

Don Felix Martinez, governor and captain-general of this kingdom, for the purpose of reducing and uniting Moquis—" (a couple of words here not decipherable). The manuscript of Father Escalante's journal before referred to also shows that there was a well-known road from Oraybe, *via* Zuñi, to Santa Fé, and which his party followed. These facts show that at least as early as 1777, and most probably as early as 1773 (the date according to Humboldt of Garces's journey to Oraybe), there was a communication all the way from Santa Fé, and without doubt from Taos, *via* Moqui, to San Gabriel; and, as Father Font's map shows, even all the way to Monterey and the bay of San Francisco.

The next published account of the earliest discoveries of any portion of the Great Basin of Utah, which has aided me very much in my historical investigations, I find, in the most excellent memoir of Lieut. Gouverneur K. Warren, Corps Topographical Engineers, United States Army, exhibiting the data and authorities from which was compiled the map of the United States territory between the Mississippi River and the Pacific Ocean, intended to illustrate the reports upon the Pacific Railroad explorations. In this memoir, which shows great labor and research, is a letter to Lieutenant Warren from Mr. Robert Campbell, a well-known gentleman of Saint Louis, who has been connected with the fur-trade in the tramontane region of the West. In this letter Mr. Campbell gives verbatim the statement of Mr. James Bridger,[i] corroborated by Mr. Samuel Tolleck, both Indian traders, to the effect that he (Bridger) was the first discoverer of Great Salt Lake, in the winters of 1824 and 1825.[k]

(*i*) Lieutenant Warren's Memoir, vol. xi, Pacific Railroad Reports, p. 35.

(*k*) Mr. Bridger further states, in Mr. Campbell's letter, that "in the spring of 1826 four men went in skin boats around it to discover if any streams containing beaver were to be found emptying into it, but returned with indifferent success." Washington Irving, in his "Bonneville's Adventures," revised edition of 1849, page 186, says: "Captain Sublette, in one of his early expeditions across the mountains, is said to have sent four men in a skin canoe to explore the lake, who professed to have navigated all round it, but to have suffered excessively from thirst, the water of the lake being extremely salt, and there being no fresh streams running into it."

Captain Bonneville doubts this report, or that the men accomplished the circumnavigation, "because," he says, "the lake receives several large streams from the mountains which bound it to the east."

It would thus appear that Sublette, in all probability, was the person who sent out the four men referred to by Bridger, in a skin canoe, to explore the lake; and, though Bonneville doubts the report of the occurrence, yet the testimony of Bridger is corroborative of it, and the circumstance of its being an actual fact that there are no streams coming into the lake on its west shore, along its whole length, and Captain Stansbury, as he says, in his survey of the lake in 1850 (see his report, page 103), "having frequently found it necessary to make a voyage of fifty miles to obtain a supply even for a few days," certainly account for the thirst of Sublette's party. It may be true that Sublette's party did not discover the fresh-water streams running into the lake from the south and east which Bonneville speaks of; but this only shows that they did not explore the lake *thoroughly*, not that they did not explore it at all. In this connection, however, I think it proper to insert the following communication of a Mr. W. Marshall Anderson, taken from the National Intelligencer, which, it will be perceived, claims for both Messrs. Ashley and Provost the credit of prior discovery of Great Salt Lake to either Bridger or Bonneville:

"'WHO DISCOVERED SALT LAKE?

"'Among the 'thousand and one' articles of freight and baggage which went down to the bay by the steamer Queen City yesterday, were two old flint-lock, smooth-bore rifles of the real old 'Kaintuck' stripe. They were brought on board by a man who looked as weather-beaten, flinty-locked, and hard-stocked as themselves. Being curious to learn their history, and who it was that possessed them, we made a few inquiries, and the owner, being mellowed by the genial influences of the corn-vintage, communicated the following facts: His name was Seth Grant, a Scotchman by birth, who came to America at an early age, in the year 1819, and joined the American Fur Company. In 1826 he accompanied Bridger—the founder of Fort Bridger—and his partner, Colonel Vasquez, to the then unknown wilds of the West, far beyond the headwaters of the Platte or Yellowstone. It was on one of these fur-seeking, marauding expeditions that the Frenchman, Colonel Vasquez, while out on an excursion, discovered the Great Salt Lake of Utah. The immense extent of the lake, with its mountains and islands, so deceived Vasquez and his party that they reported to their fellows that they had discovered an arm of the Pacific Ocean, and so, indeed, it seemed, for it was years before the error was

The next authentic account of any discoveries within the Great Basin I find given in "Bonneville's Adventures," by Washington Irving. Colonel Bonneville, it would appear, was the first explorer to cross, in 1832, the Rocky Mountains into the valley of Green River, *with wagons*.[1] To quote from Irving:

"On the 24th July, 1833, by his (Captain Bonneville's) orders, a brigade of 40 men set out from Green River Valley to explore the Great Salt Lake. They were to make the complete circuit of it, trapping on all the small streams which should fall in their way, and to keep journals and make charts calculated to impart a knowledge of the lake and the surrounding country. All the resources of Captain Bonneville had been taxed to fit out this favorite expedition. The country lying to the southwest of the mountains, and ranging down to California, was as yet almost unknown; being out of the buffalo range, it was untraversed by the trapper, who preferred those parts of the wilderness where the roaming herds of that species of animal gave him comparatively an abundant and luxurious life. Still, it was said the deer, the elk, and the big horn were to be found there, so that, with a little diligence and economy, there was

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corrected. The two rifles in possession of Mr. Grant were a portion of the arms of the original party, and bore the marks of having seen long and honorable service. Mr. Grant values them highly, and being on his way back to his own native land, intends taking them as trophies, to be hung up with the tartans and claymores of his countrymen.'—*Sacramento Standard.*

"SEVEN OAKS, *February* 16, 1860.

"*Messrs. Editors of the National Intelligencer:*

"Allow me to call your attention to the above paragraph, credited to the Sacramento Standard. The writer, on the authority of a Mr. Seth Grant, says that my old friend Vasquez, of the Rocky Mountains, was the discoverer of the Great Salt Lake, of Utah. The honor could not possibly have been bestowed upon a worthier man. Can this geographical fact be now ascertained and settled beyond dispute? Was Colonel Vasquez the discoverer of that remarkable body of water? My answer is, no. I not only doubt, but I emphatically deny, that statement. A little more than a quarter of a century ago I heard the very subject of the priority of its discovery debated by old mountaineers, almost in the vicinity of the lake itself. To furnish better proof than unassisted memory, I send you the following extract from a letter written by me in 1837, at the request of the venerable Skinner, and published in the 8th volume of the American Turf Register:

"'Here, for a time, I will end my description of the animals of the boundless prairies, and here, too, I will end this hasty letter, after protesting, solemnly protesting, against an act of injustice done to a numerous, brave, and adventurous class of our western citizens, by our much admired Irving, or by Captain Bonneville through him. In the name of Sublette, Fitzpatrick, Fontinelle, Deippes, Bridger, and Campbell, I protest against the name 'Lake Bonneville,' given by the author of 'Astoria' and the 'Rocky Mountains' to that great inland sea, the 'Urimiah' of our continent. In the name of Ashley, who had described this lake eighteen or twenty years before Captain Bonneville ever crossed the mountains, I protest against that name. What justice, what honor can there be, in claiming the right of naming that 'wonder of the western waters' after Bonneville, when it had been found, circumambulated, and trapped on as early as 1820 by Provost? This lake was once called 'Ashley,' and with much more propriety, high and respected as is the authority of Irving. '*Fiat justitia.*'"

"The above was written at the time indicated, from my journal-notes, taken down in the presence of the interlocutors in 1834. Provost was then 'no more.' Neither praise nor censure could reach him. His survivors and brothers in the hardships and hazards of mountain life gave to him alone the credit of having discovered and made known the existence and whereabouts of that inland sea. Notwithstanding the positive assertion of Seth Grant, 'made under the genial influence of the corn-vintage,' I deny its truth. I will not pursue the subject further than to add that only eight years had elapsed since Vasquez and his companions had come upon 'that arm of the Pacific Ocean,' and yet he, then present, made no claim, and his associates, and equals, of both the American and Rocky Mountain Fur Companies, with whom he was the general favorite, did not assign him even a secondary honor.

"Confidently appealing to my surviving friends and acquaintances of the mountains for correction or confirmation, I assure you, gentlemen, of the reverential esteem of

"W. MARSHALL ANDERSON."

(*l*) "Captain Bonneville now considered himself as having fairly passed the crest of the Rocky Mountains, and felt some degree of exultation in being the first individual that had crossed, north of the settled provinces of Mexico, from the waters of the Atlantic to those of the Pacific, with wagons. Mr. William Sublette, the enterprising leader of the Rocky Mountain Fur Company, had two or three years previously reached the valley of the Wind River, which lies on the northeast of the mountains, but had proceeded with them no farther." (Bonneville's Adventures, rev. ed., p. 61.)

no danger of lacking food. As a precaution, however, the party halted on Bear River, and hunted for a few days, until they had laid in a supply of dried buffalo meat and venison; they then passed by the headwaters of the Cassie River, and soon found themselves launched on an immense sandy desert. Southwardly, on their left, they beheld the Great Salt Lake, spread out like a sea, but they found no stream running into it. A desert extended around them, and stretched to the southwest as far as the eye could reach, rivaling the deserts of Asia and Africa in sterility. There was neither tree nor herbage, nor spring, nor pool, nor running stream, nothing but parched wastes of sand where horse and rider were in danger of perishing.

"Their sufferings at length became so great that they abandoned their intended course, and made toward a range of snowy mountains, brightening in the north, where they hoped to find water. After a time they came upon a small stream, leading directly toward these mountains. Having quenched their burning thirst, and refreshed themselves and their weary horses for a time, they kept along this stream, which gradually increased in size, being fed by numerous brooks. After approaching the mountains it took a sweep toward the southwest, and the travelers still kept along it, trapping beaver as they went, on the flesh of which they subsisted for the present, husbanding their dried meat for future necessities.

"The stream on which they had thus fallen is called by some Mary's River, but is more generally known as Ogden's River, from Mr. Peter Ogden, an enterprising and intrepid leader of the Hudson's Bay Company, who first explored it."[m] * *

"The trappers continued down Ogden's River, until they ascertained that it lost itself in a great swampy lake, to which there was no apparent discharge. They then struck directly westward across the great chain of California mountains intervening between these interior plains and the shores of the Pacific.[n]

"For three and twenty days they were entangled among these mountains, the peaks and ridges of which are in many places covered with perpetual snow. Their passes and defiles present the wildest scenery, partaking of the sublime rather than the beautiful, and abounding with frightful precipices. The sufferings of the travelers among these savage mountains were extreme; for a part of the time they were nearly starved. At length they made their way through these, and came down upon the plains of New California, a fertile region extending along the coast, with magnificent forests, verdant savannas, and prairies that look like stately parks. Here they found deer and other game in abundance, and indemnified themselves for past famine. They now turned toward the south, and, passing numerous small bands of natives posted upon various streams, arrived at the Spanish village and post of Monterey."[o]

It would thus seem that Walker and his party failed in exploring around the west portion of the Great Salt Lake on account of the desert in that region, and were forced to take a route along the northern section of the Great Basin to California; and it is

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(*m*) Since the explorations of Frémont in 1845–'46, this river has been known altogether by emigrants and others as the Humboldt River, the name Frémont gave it.

(*n*) Irving is here in error. Walker did not go directly *westward* from the Swamp (sink) of the Ogden's River (the Humboldt) across the great chain of California mountains (the Sierra Nevada), but striking southwardly, continued down along their *east* side for nearly 5° of latitude before he crossed them, near their southern termination, by a pass since known as Walker's Pass. I get this information from Mr. E. M. Kern, the assistant of Frémont, who ten years subsequently was guided by Walker over this very route. (See Kern's Journal, Appendix Q.)

(*o*) Bonneville's Adventures, pp. 326–328.

represented by Irving that on their return they turned the Sierra Nevada at its southern extremity. This being the case, it is likely they took the Spanish trail route, which Frémont, ten years after, in 1844, followed, and on which, at Vegas de Santa Clara, he was overtaken by this same Joseph Walker, in charge of a trading-party.

The next authentic account we have of any explorations of the Great Basin is from the report by Colonel Frémont of his expedition, in 1843–'44, to Oregon and California, through the South Pass, where, on the 6th September, of the former year, he attained the summit of a butte near the mouth of Weber River, whence he saw, for the first time, the waters of Great Salt Lake.[p]

Forming an encampment near the mouth of the Weber, he remained in the vicinity a few days to make some observations and take a hasty sketch of the lake.

Subsequently, in continuation of his expedition, he explored in the following winter from Fort Vancouver along the east base of the Sierra Nevada, or along what may be called the northwestern edge of the Great Basin, as far as the vicinity of Johnson's Pass, where he crossed the Sierra to the valley of the Sacramento. On his return east in the spring of 1844 he turned the Sierra Nevada at its southern extremity, got upon the Spanish trail along the Mojave River in the Great Basin, crossed the Rio Virgin and other tributaries of the Colorado, and, near Las Vegas de Santa Clara, again entered the Great Basin, and explored it along its southern and eastern edge up to the eastern portion of Lake Utah, where he left it and crossed the dividing ridge into the valley of Green River.

Colonel Frémont's report shows that in this expedition he had not seen, or did not care to give heed to, the previously published history and map of the explorations of Bonneville; for, had he done so, he would probably not have been led into the error to which he attributed a great deal of his hardships, of constantly looking for the hypothetical river of Buenaventura, which, as he supposed, taking its rise in the Rocky Mountains, emptied itself into the bay of San Francisco, and upon which he expected to winter. His language is as follows:

"In our journey across the desert, Mary's Lake" [most probably the sink of the Humboldt, formerly called Mary's River] "and the famous Buenaventura River were two points on which I relied to recruit the animals and repose the party. Forming, agreeably to the best map in my possession, a connected water-line from the Rocky Mountains to the Pacific Ocean, I felt no other anxiety than to pass safely across the intervening desert to the banks of the Buenaventura, where, in the softer climate of a more southern latitude, our horses might find grass to sustain them and ourselves be sheltered from the rigors of winter and from the inhospitable desert."[q]

Touching this question, Colonel Bonneville, in a letter to Lieutenant Warren on the subject of his explorations in and west of the Rocky Mountains, uses the following language; and as it bears upon the fact as to whom should be accorded the credit of the discovery of the Great Basin, I think proper to make an extract from it. I find the letter in Lieutenant Warren's Memoir of Explorations, page 33:

"GILA RIVER, N. MEX., *August* 24, 1857.

"DEAR SIR: I thank you for your desire to do me justice as regards my map and

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(p) Frémont's Report, House Cong. Doc. No. 166, p. 151, published in 1845.

(q) Frémont's report for 1843–'44, p. 205; see also pp. 196, 214, 219, 221, 226, 255, explorations in the Rocky Mountains. I started for the mountains in July, 1832. * * * I left the mountains in July, 1836, and reached Fort Leavenworth, Mo., the 6th of August following. During all this time I kept good account of the courses and distances, with occasional observations with my quadrant and Dolland's reflecting telescope. * * * I plotted my work, found it proved, and made it into three parts: one a map of the waters running east to the Missouri State line; a second of the mountain region itself; and a third, which appears to be the one you have sent me, of the waters running west. On the maps you send I recognize my names of rivers, of Indian tribes, observations, Mary's or Maria's River, running southwest, ending in a long chain of flat lakes, never before on any map, and the record of the battle between my party and the Indians, when twenty-five were killed. This party clambered over the California range, were lost in it for twenty days, and entered the open locality to the west, not far from Monterey, where they wintered. In the spring they went south from Monterey, and turned the southern point of the California range, to enter the Great Western Basin. On all the maps of those days the Great Salt Lake had two great outlets to the Pacific Ocean; one of these was the Buenaventura River, which was supposed to head there;[r] the name of the other I do not recollect. It was from my explorations and those of my party alone that it was ascertained that this lake had no outlet; that the California range *basined* all the waters of its eastern slope without further outlet; that the Buenaventura and all other California streams drained only the western slope. It was for this reason that Mr. W. Irving named the Salt Lake after me; and he believed I was fairly entitled to it. * * * * *

"Yours, &c.,

"B. L. E. BONNEVILLE,
"*Colonel Third Infantry.*

"Lieut. G. K. WARREN,
"*Topographical Engineers.*"

It would appear from Colonel Frémont's report that it was a favorite purpose of his, on his return from California, to *cross* the Great Basin *directly*, instead of turning it at its southern extremity. He is speaking of what occurred as he was turning the southern end of the Sierra Nevada, by the Tah-e-chay-pah Pass, to get on the Spanish trail. "In the evening a Christian Indian rode into the camp, well dressed, with long spurs and a *sombrero*, and speaking Spanish fluently. It was an unexpected apparition and a strange and pleasant sight in the desolate gorge of a mountain—an Indian

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(*r*) Colonel Bonneville is here probably in error. On Finley's map of North America (Philadelphia, 1826), given by Lieutenant Warren in his Memoir, p. 30, and which purports to include all "the recent geographical discoveries" up to the date stated, the Buenaventura is represented not as one of the outlets of Great Salt Lake into the Pacific, but as the outlet of Lake Salado, doubtless the Lake Sevier of our present maps. The two rivers which are represented on this map as disemboguing from the Great Salt Lake into the Pacific are the Rio Los Mongos and Rio Timpanogos. The fact of Father Escalante in 1776 giving the name of Buenaventura to a river (evidently from the plotting of his notes, Green River) which on Humboldt's map is represented as flowing westwardly into Lake Salado (Sevier) from the Rocky Mountains, the western limits of which he has left undetermined, points, I think, to the origin of the Rio Buenaventura, and of its subsequent hypothetical extension from Lake Sevier to the Bay of San Francisco. It is due, however, to the accuracy of Escalante to say that he expressly states in his journal that from the manner the Indians spoke of the Sevier River, which he followed and which he calls the Santa Ysabel, he was led to the idea that it and the Buenaventura were the same stream; though he could not really think so, for the reason that there was not enough water in the Sevier. He, however, represents that the Santa Ysabel, after emptying into a lake, flows out of it westwardly, and this may have given rise to the idea that it continued to the Pacific.

face, Spanish costume, jingling spurs, and horse equipped after the Spanish manner. He informed me that he belonged to one of the Spanish missions to the south, distant two or three days' ride, and that he had obtained from the priests leave to spend a few days with his relations in the Sierra. Having seen us enter the *pass*,[s] he had come down to visit us. He appeared familiarly acquainted with the country, and gave me definite and clear information in regard to the desert-region east of the mountains. I had entered the pass with a strong disposition to vary my route, and *to travel directly across toward* the Great Salt Lake, in the view of obtaining some acquaintance with the interior of the Great Basin, while pursuing a direct course for the frontier; but his representation, which described it as an arid and barren desert, that had repulsed by its sterility all the attempts of the Indians to penetrate it, determined me for the present to relinquish the plan, and, agreeably to his advice, after crossing the Sierra, to continue our intended route along its eastern base to the Spanish trail." [t]

Thus, like Father Escalante and Walker, Frémont was foiled of directly crossing the Great Basin, on account of its reported arid nature, and evaded it by keeping along its southern edge.

The next authentic account we have of any explorations within the Great Basin is to be found in the pamphlet entitled "Geographical Memoir upon Upper California, in illustration of his map of Oregon and California, by John Charles Frémont, addressed to the Senate of the United States." [u] This memoir and the accompanying map show that Colonel Frémont entered the Great Basin by way of the Timpanogos River,[v] followed down the valley of Utah Lake and its outlet, the Jordan River, to its mouth in Great Salt Lake; turned this lake at its southern extremity; passed westwardly by Pilot's Peak to Whitton's Spring; and thence his party was divided, Mr. E. M. Kern, with Joseph Walker as guide, striking northwestwardly for the Humboldt (Mary's) River, following it down to its sink, and thence striking southwestwardly, and passing along the east shore of Carson Lake, to Walker's River; and Colonel Frémont, with Carson and Godey as guides, and a portion of the party, striking southwestwardly more directly across the Great Basin to near Walker's Lake, where the parties again met. Here separating again, Mr. Kern, guided by Walker, proceeded southwardly to the head of and along Owen's River and Lake, and thence to Walker's Pass of the Sierra Nevada, where he left the basin and crossed the Sierra into the valley of Lake Tulare

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(*s*) Frémont (pp. 248 and 270 of his Report) calls this *Walker's* Pass, but Mr. E. M. Kern, one of his assistants at the time, informs me that Walker's true pass was about half a degree to the north of this, and was the pass through which Walker, the discoverer of it, led him in 1845. The pass through which Frémont went was the Tah-e-chay-pah Pass. (See Kern's Journal, Appendix Q; also Lieutenant Williamson's Report Pacific R. R. R., vol. v, pp. 17 and 19.) I notice, however, that Frémont in his letter to the editor of the National Intelligencer, dated June 13, 1854, speaks of both these passes as Walker's, which is the fact so far as that Walker passed into the valley of the San Joaquin by the more northern one, in 1833, and the next year out of it by the other, the Tah-e-chay-pah. (See note *o*.) The charge of error upon Frémont has arisen, doubtless, from the circumstance that he did not in his report of 1843 and 1844 speak of both the passes, but refers to but one, and that not usually denominated Walker's Pass.

(*t*) Frémont's Report, p. 254..

(*u*) Senate Miscellaneous Doc. No. 148, 30th Cong., 1st Sess.

(*v*) Frémont's map represents that he passed from the Duchesne's Fork, up Morin's Fork, and thence across the divide to the Timpanogos. This was a physical impossibility, for Morin's Fork, or White Clay Creek, as it is now called, is a tributary of the Weber, and instead of running into Duchesne's Fork, and being thus a tributary of the Colorado, is, on the contrary, a branch tributary of the Great Salt Lake. In other words, Duchesne's Fork and Morin's Fork are on opposite sides of the divide (the Uintah range), and, therefore, could not *both* be followed up from the Colorado side.

and the Rio San Joaquin. Frémont, on the contrary, traveled northwardly to Carson River, where he crossed it at the same point as in his preceding exploration; and thence to Salmon Trout Creek, up which he traveled and crossed the Sierra Nevada, in latitude 39° 17′ 12″ N., or 38.2 miles north of his pass of 1844.

For a very interesting account of Mr. Kern's branch expedition above alluded to, I refer to his journal, (Appendix Q,) now for the first time given to the public, and which he has kindly submitted to me for this purpose; and as it goes into the particulars of his exploration of the country along the Humboldt River, Carson, Walker's, and Owen's Lakes, the plat of which furnished the basis for Colonel Frémont's map accompanying his memoir, but a detailed report of which the latter has never given, I consider it a valuable addition to the knowledge of the Great Basin, and take this opportunity of thanking Mr. Kern for it.[w]

The geographical memoir of Frémont, as already stated, does not enter into the particulars of his exploration of 1845 and 1846, but only gives a general view of the Great Basin. This view is graphic, and in the main, so far as my observations extended, just, and corrects some errors into which, from imperfect data, he had fallen in his previous explorations. The idea which he had entertained of the Basin's being made up of a *system of small lakes and rivers, scattered over a flat country,*[x] was found to be entirely untrue, and, on the contrary, that the *mountain* structure predominated.[a] The long stretch of mountain range, however, which on his map is represented as being the continuation westwardly of the Wahsatch range, and as separating the waters of the Great Basin from those of the Colorado, is evidently hypothetical.[b]

(*w*) Mr. Kern, it seems, got on the Humboldt, on a then *old California emigrant wagon-road,* which followed the Humboldt down to its sink, and then crosses over to the Carson River and, following up its valley, crosses the Sierra Nevada at the head of the South Fork of the American River. This is the route which Hastings and many others who preceded Frémont traveled over with wagons, and which emigrants have since continued to take. Kern followed this well-beaten road to near Carson Lake, where he left it. I get this information from him personally, and besides, he speaks of this "emigrant wagon-trail" (as he calls it) in his journal. I have endeavored to find out who first tracked this road; but all I can learn in addition to what Mr. Kern has informed me is the following, which I extract from "*The Annals of San Francisco,*" published by Appleton & Co., 1855, pp. 85, 86:

"So early as 1837, several societies were formed in the American States to promote emigration to Oregon and California. In the following years, and particularly in 1843, 1844, 1845, and 1846, many thousand emigrants journeyed across the Rocky and Snowy Mountains, enduring much suffering by the way, to settle in California and the adjacent territory of Oregon."

I have thus been particular in this matter for the reason that in Frémont's memoir it is not made clear that such a road did exist at the time of his exploration, and that his expedition followed it. And I would here remark that it is to be regretted that officers having charge of exploring expeditions do not always report when they are following *old wagon-roads,* so that a full history of the route may be given. Had this been done, a great deal of injustice which has been exercised to other officers since the explorations of Frémont would have been spared, and more liberal and just reports made.

Since penning the foregoing, Mr. Kern has courteously furnished me with the following extract from a letter dated San Francisco, November 3, 1860, from Maj. J. R. Snyder:

"Dr. Townshend and party brought wagons as far as Truckee Lake in 1844. I am not confident that he succeeded in getting them over the mountains. Moses Shellenberger remained all winter at the lake with the property, and I think in the spring they had assistance to bring everything to the fort.

"Our party in 1845 brought wagons through the Johnson's Pass to the headwaters of Bear River, and so on through the Sacramento Valley, without interruption. This was, probably, the first party that came directly through. There was no trail or the sign of any where we passed, from the Oregon road, over the Goose Creek Mountains, to the head of Mary's (Humboldt) River."

(*x*) Frémont's Report, p. 235.

(*a*) Frémont's Memoir, p. 7.

(*b*) On Frémont's map illustrating his explorations of 1845 and 1846, and which he says in his Memoir, p. 3, was prepared under his directions, it is represented that this extensive chain of mountains was "seen from elevated points on his northern exploring line." I think the colonel must have labored here under a misapprehension, for I passed more

This view, however, in no way militates against the theory and fact of the Great Basin system as one distinct from the valley of the Colorado; because, as is to be seen in many instances in the basin itself, a very slight rim or rise of ground may be the divide between distinct sub-basin systems.

The next authentic account, in the order of dates, we have of explorations within the Great Basin, is to be found in the report by Capt. Howard Stansbury, Topographical Engineers, of his "*Exploration and Survey of the Valley of the Great Salt Lake of Utah in* 1849," published by order of Congress. This report I cannot but regard, in a geographical point of view, as of great value. I have had occasion, in many instances, in my reconnaissances west of the Rocky Mountains and in the region of the Great Salt Lake, to test the accuracy of Captain Stansbury's work; and it has been a gratification to me to find that his report and map have represented the country so correctly and have been of so much service to me. To him and his assistant, the lamented Captain Gunnison, Topographical Engineers, the public is indebted for a thorough triangular survey of the Great Salt Lake; and to them is the credit due of a complete exploration of the lake, around its entire limits, a feat which Joseph Walker, by Colonel Bonneville's directions, attempted, as before stated, sixteen years previously; but which, on account of the desert lying on its west and the consequent want of fresh water, he failed to execute. Stansbury, however, extended his explorations into the Great Basin only as far as Pilot Knob, a prominent landmark sixty-four miles in a due west direction from Great Salt Lake.

The next authentic account of explorations in the Great Basin is that by Capt. E. G. Beckwith, Third Artillery, the assistant of Captain Gunnison in his expedition for the survey of a railroad-route near the 41st parallel, and who took charge of the expedition after the massacre of Gunnison and a portion of his party by Indians, on Sevier River, on the 26th October, 1853. The party entered the Great Basin from the valley of Green River by the Wahsatch Pass and a creek he calls Salt Creek, a branch of the Sevier;[c] and thence they returned to the usually-traveled route from Los Angeles, and proceeded, by the way of Nephi, Payson, Provo, &c., to Great Salt Lake City.

In the ensuing year, 1854, Captain Beckwith explored some of the tributaries of Great Salt Lake and Utah Lake, issuing from the Wahsatch and Uinta Mountains, and, passing by the southern end of Great Salt Lake, he struck generally a north-of-

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than a degree nearer to these mountains than he did, and I saw nothing of them. Besides, I notice in his letter to the editor of National Intelligencer, dated June 13, 1854, constituting Mis. Doc. House of Reps. No. 8, 33d Cong., 2d Sess., that he passed right along where he has located this extensive range, and yet he says nothing to *confirm* his previous report. On the contrary, his language in reference to this portion of his route is: "We found the country a high tableland, bristling with mountains, often in short, isolated blocks, and sometimes accumulated into considerable ranges with numerous open and low passes." I have, therefore, no doubt that the representation of this long chain of mountains on the maps of Utah, by Colton, Monk, and Mitchell, is a fiction, and should be discontinued.

(*c*) Messrs. Beale and Heap passed over nearly this same route in 1853, in advance of Captain Gunnison's party, and after reaching Vegas de Santa Clara, took the Spanish trail route to California. (See Heap's Journal, published by Lippincott, Grambo & Co., 1854.) This journal gives a statement of Rev. J. W. Brier, in which he represents that he and a small party found their way, in the fall of 1849, from Vegas de Santa Clara, in a tortuous and, in general, a southwestwardly course, across the southwest corner of the Great Basin to Walker's Pass.

Colonel Frémont, also, subsequently, during the winter of 1853–'54, followed very nearly the route of Captain Gunnison to Grand River, and thence to Parowan and Cedar City on the Spanish trail. Thence his course was directly west, over the Great Basin to the Sierra Nevada, which, on account of snow, he was obliged to cross over by Walker's Pass, some sixty to eighty miles to the southward. (See Frémont's letter to editor National Intelligencer, of June 13, 1854, constituting House Mis. Doc. No. 8, 2d Sess. 33d Cong.)

west course across the Great Basin to the Humboldt Pass of the Humboldt range; thence southwestwardly in Ruby Valley to the Hasting's Road Pass of this same range; and thence northwestwardly across the mountains to the south of the Humboldt, to Lassen's Meadows, on the Humboldt River. Thence his course was westwardly through the valley of the Mud Lake to the Madelin Pass of the east range of the Sierra Nevada, where he left the Great Basin.[d] It will be noticed that up to this time this was the most direct exploration which had been made across the Great Basin from Great Salt Lake City; but yet it was too far north and too tortuous to be of great value as offering a *direct* wagon-route to Placerville, Sacramento, and San Francisco. Besides, as a wagon-route to Lassen's Meadows I believe it has never been used, on account of its roughness, west of the South Fork of the Humboldt.

The next report we have of an attempt being made to cross the Great Basin directly from Great Salt Lake City toward Walker's Lake, for the purpose of avoiding the great detour by the Humboldt River, and getting the shortest route to San Francisco, is to be found in the report of Capt. Rufus Ingalls, United States Army, to the Quartermaster-General, dated August 25, 1855, giving an account of the movements of Colonel Steptoe's command to and from Great Salt Lake City. His language on this point is as follows:

"The wagon-routes across the continent are so very rough in mountainous regions, and always quite circuitous, particularly from Great Salt Lake City to the Bay of San Francisco, that Colonel Steptoe took measures to have the country lying directly west explored for a more nearly air-line road. Two Mormons were engaged as principal explorers, and directed to explore from the south end of the Great Salt Lake on the Beckwith route, or near to it, to Carson Valley. This party left the lake in September, and returned the following November. It proved quite an expensive trip, owing, in my present opinion, to the tricky character of the Mormons. They made a most flattering report. They said they had discovered a wagon-road along which a command could move with ease, &c., saving 150 or 200 miles. The colonel had not seen Lieutenant Beckwith's report, nor had he any other information than that given by his exploring party; but being deeply sensible of the importance to the Territory of Utah and the overland emigrants of laying out and opening a more direct and practicable road than the crooked ones now traveled, he determined to take his command and the large wagon-train over this new route.

"As spring approached, however, the chief Mormon who had agreed to act as guide became rather restive, and evinced an unwillingness to go, which caused the colonel to distrust him, and shook his confidence in the report he had made of the road. As a matter of security another party was organized, under 'Porter Rockwell,' a Mormon, but a man of strong mind and independent spirit, a capital guide and fearless prairie man. He went out as far as the great desert tracts lying southwest of the lake, and very nearly on a level with it, and found that at *that season* they could not be passed over, 'unless with wings,' and returned. It proved fortunate that we did not undertake the march with O. B. Huntington as guide. The march would have been disastrous; though Rockwell and others are of the opinion that, by going on a line some thirty miles farther south, along the foot of mountains seen in that direction, a fine road can be laid out, avoiding, in a great degree, the desert. I believe such to be the case myself. I am clearly of the opinion that a suitable officer could, by a proper reconnaissance, lay out a road passing by 'Rush Valley,' turning southward and going by New River, Walker's Lake, into Carson Valley, and save 200 miles distance.

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[d] P. R. R. R., vol. ii.

"This route having been declared impracticable, the colonel decided to pass around the north end of the lake, and thence by the Humboldt to Carson Valley."[e]

It thus seems that Colonel Steptoe was deterred from attempting a direct route across the Great Basin toward San Francisco by the reports which he had received, and took the old roundabout road by way of the Humboldt River.[f]

I have now, as I believe, exhausted the subject of the explorations in and around the Great Basin up to the time of my reporting for duty with the army under General A. S. Johnston in Utah. This history shows that, up to this period, a direct road toward San Francisco, from Great Salt Lake or Camp Floyd across the Great Basin, had never been thoroughly attempted, but that in every instance, from fear of encountering reported deserts, explorers had shrunk back from the task. It was universally believed in Utah that, at this period, not even a Mormon had ventured to cross the Basin in this direct manner toward Carson or Walker's Lake, though their settlements in Carson Valley made such a route so desirable.

Some individuals, more venturous than others, had made a less circuitous bend than the old route by the Humboldt River, but yet a direct journey across not one had effected.

It was this failure on the part of others to accomplish this desirable exploration, as well as the possible advantages of a new and short road to San Francisco, which stimulated me to submit, through General Johnston, a project of exploration to the War Department, which had in view the accomplishment of this very enterprise, and thus, if possible, the opening of a wagon-road which would be of benefit to the Army and country. This project of exploration is inserted in the first page of my journal, and to it do I refer for particulars. Suffice it here to remark, it was approved by General Johnston, and met with the sanction of the Secretary of War, Hon. John B. Floyd, and upon the authority of the latter the expedition was ordered, and received the thorough outfit it did at the hands of the former.

The result of the expedition has been the opening of a wagon-route which, starting from Camp Floyd, branches 28 miles distant into two generally parallel routes, which come together again at a distance from Camp Floyd of 286 miles, and thence are generally coincident the rest of the way to Genoa, at the east foot of the Sierra Nevada. The distance from Salt Lake City to Genoa, by my more northern or outward route, and the cuts-off which I made on my return, is 571 miles, and from Camp

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(*e*) See Appendix A, Quartermaster-General's Report, accompanying Secretary of War's Annual Report, 1855, vol. i, part ii, constituting Ex. Doc. No. 1, House of Reps., p. 156, 34th Cong., 1st Sess.

(*f*) Mr. John Kirk, superintendent of a road-making party, under instructions from the Interior Department, passed over the road from Honey Lake, by way of the Humboldt River, to the City of Rocks. His assistant engineer, Mr. Francis N. Bishop, in his report refers to the reports of Frémont and Beckwith for information respecting the country traversed. (See Report upon Pacific Wagon Roads, by Albert H. Campbell, General Superintendent, Ex. Doc. No. 108, H. R., 35th Cong., 2d Sess., pp. 36, 38.)

Floyd to Genoa 531 miles. By the old Humboldt route, according to the itinerary in Captain Marcy's "Prairie Traveler," the distance from Salt Lake City to Reese's Ranch, Genoa, is 774 miles; and as Camp Floyd is 40 miles from Great Salt Lake City, the distance from Camp Floyd to Genoa, by this route, is 814 miles. That is, my more northern route from Salt Lake City to Genoa is 203 miles shorter than the old Humboldt River route, and from Camp Floyd 283 miles shorter.[g] By my return, a more southern route, the distance from Genoa to Camp Floyd is 560 miles, or 29 miles longer than my outward route; but while longer, in grade, grass, and extent of cultivable soil, it is better. Both these new routes have been since traveled by emigrants and droves of cattle, and continue to be traveled by them, and upon the more northern is now running the mail and pony express. The Placerville and Saint Joseph Telegraph Company are now also extending their wires along it, and have already reached, as I am informed, Fort Churchill, at the bend of Carson River eastwardly from San Francisco,[h] and from Saint Joseph, Mo., westward, the telegraph is in operation as far as Fort Kearney, on the Platte River. The easy connection of my inward or southern route from Chapin's Spring with Captain Gunnison's along the Sevier River and Grand River will also be apparent, as well as the great advantage of the new wagon-road pass I explored at the head of Coal Creek, a tributary of the Timpanogos River, for the extension of my routes over the Uintah Mountains, and by the way of Duchesne's Fork, White River, and the Middle Park of the Rocky Mountains to Denver City in Kansas; and thence to Saint Joseph or Leavenworth City. The map herewith, on which will be seen these routes, and the topography of the country traversed, and to which, in reading the journal, constant reference should be had, has been projected upon the polyconic method on a scale of $\frac{1}{1,000,000}$, and the meridians and parallels of latitude laid down agreeably to data obtained from the tables arranged by Mr. J. E Hilgard, and published in the annual report of Professor A. D. Bache, Superintendent of the United States Coast Survey, for 1856.

(*g*) It will be noticed that in my project of explorations to the War Department, of January 6, 1859, I stated that I hoped to shorten the old route from Camp Floyd, 260 miles. The actual shortening has been 283 miles.

(*h*) In the above I say nothing about the comparative advantages between my routes and the old Humboldt route, except that to those emigrants *who go by the way of Salt Lake City or Camp Floyd,* there is no question that my route are far preferable, being 203 miles shorter in the first case and 283 in the second, and doubtless as good in respect to hardness, water, and grass, and a great deal better as regards wood. To enable the emigrant, however, as he reads my journal, to institute some sort of comparison between the routes, I give below some extracts from the reports of different Government officials in respect to the character of the old route along the Humboldt River, and inform him, at the same time, that while on my routes at either end there is some desert country to go over, yet that besides the alkaline water, grass, and mire, which emigrants on the old road have to contend with along the Humboldt, they have to cross, in the case of their taking hence the Carson River route, a desert of 45 miles and another of 26; and in the case of the Honey Lake route, also a desert of about 60 miles where there is a scarcity of water and grass. I would also state that the distance from the Missouri River, *via* South Pass, Great Salt Lake City, and my shortest route across the basin, is 41 miles shorter than that by Landers's "Cut-off" and the Carson River route, to San Francisco, and 55 miles shorter than by his "cut-off" and the Honey Lake road.

Lieutenant Beckwith, vol. ii, P. R. R. Reports, speaking of the Humboldt River, June 4, 1854, at Lassen's Meadows, uses the following language:

> "We moved camp 6.80 miles down the river to a point selected for crossing it, where it has no bottom-land upon it. These low lands being very much overflowed at this season, and miry, are entirely impassable for horses or cattle; and many arriving here in a weak condition, are annually lost by emigrants from becoming mired. But one of the chief causes of the loss of cattle by emigrants upon this stream is allowing them to eat the grass in the river-bottom, which is extremely unwholesome. The more experienced stock-drovers to California send their cattle back from the river to feed on the nutritious grass of the hills; but as these are frequently distant from the road and from water, it is only by experience that men learn its importance."

And Maj. I. Lynde, Seventh Infantry, in his report to General A. S. Johnston, of October 24, 1859, states that he

For the particulars of each day's travel across the Great Basin, as well as a minute description of the country traversed, I refer to my journal. But as a previous general account always renders an examination into particulars more satisfactory, it may not be unacceptable to say something in this regard.

The first thing which will strike one, on looking at the map, will be the *great number of mountain ranges* which the routes cross in the Great Basin; and this will appear to him the more remarkable, as the idea has been generally entertained, since the explorations of Frémont in 1843 and 1844 (though, as before remarked, he corrected the error in his succeeding expedition), that this Great Basin was a *flat country, scattered over with a system of small lakes and rivers*, and destitute of mountains. The fact, on the contrary, is that it is the most mountainous region, considering its extent, we have probably within the limits of our domain; and so far from being scattered over with a system of small lakes and rivers, which seem to imply a considerable number of this kind of water area, it has but a limited number of lakes, and they almost entirely confined to the bases of the great Sierra which bound the Basin.

These lakes are, proceeding from north to south and along the circumference of the Great Basin, Great Salt Lake, Lake Utah, Sevier Lake, and Small Salt Lake, on the eastern side of the Basin; and on the western, proceeding from south to north, Soda Lake, Owen's Lake, Walker's Lake, the two Carson Lakes, Humboldt Lake, Pyramid Lake, the Mud Lakes, and Lake Abert. Beside these, there are Franklin Lake and Goshoot Lake, which are to be seen to the east of the East Humboldt range.

These constitute all the lakes that have been discovered in the Great Basin, and they are all without outlet. Great Salt Lake is 70 miles long and from 20 to 30 broad. Pyramid Lake and Walker's Lake, the next largest, are both 30 miles long by 10 wide. All the others are smaller. Pyramid Lake, Walker's Lake, and Utah Lake, which are

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reached Gravelly Ford, on the Humboldt, 12th July, and found "the mosquitoes and flies very troublesome to the men and animals, and the water very much impregnated with alkali." He proceeded thence down the river 118 miles, and says, "the greater part of this distance the valley, which does not average more than three-fourths of a mile in width, was covered with water, and deep sloughs running parallel to the river render it impossible to reach the main stream except at long intervals. The water in these sloughs was so much impregnated with alkali as to render it dangerous for the animals to drink it, and the mosquitoes and flies were worse than I ever saw them before." (See doc. accompanying Secretary of War's Report, of 1860. See also the testimony of my guide, Mr. John Reese, on this point, in my journal, under date of June 12.)

It seems from Mr. Albert H. Campbell's report to the Secretary of the Interior, of February 19, 1859, that Mr. John Kirk, the superintendent of the Humboldt division of the wagon-road, "was instructed to select a road from Honey Lake Valley to City of Rocks, avoiding as much as possible the Humboldt, leaving it to the south," the reason assigned being "the alleged deleterious character of the waters of the river, and its destructive effects upon cattle and horses, which rendered it advisable to avoid it as much as possible." It appears, however, from reading Mr. Kirk's report, that he failed in finding any better route, and besides, speaks most encouragingly of the quality of the water and grass along the Humboldt. His language is: "It is believed that the experience of this season will correct the current opinion in relation to the pernicious qualities of the water of the river and the grass upon its bank. Except at the lake and its vicinity, we found the water good and the grass superior, both in quantity and quality. From the examinations already made, it is evident that the greatest difficulty in the road is between the west bend of the Humboldt and California." He does not say why, but probably it is on account of the desert.

I give the above statements, and it is for the reader to draw his own inference in respect to the character of the water and grass generally along the Humboldt toward its lower end and westward toward the Sierra Nevada. I mention these objections to this route, not to condemn it—for if emigrants do not go by the way of Salt Lake City or Camp Floyd, it may possibly be the most advantageous route—but only that, as already remarked while reading my journal, they may be enabled to institute for themselves some sort of comparison and arrive at some definite conclusion in the matter; for, after all, in the selection which emigrants make of any of the routes across the continent, they will always find that it will be a selection of that which is comparatively better and not that which is absolutely good. Every one of them, they will find, have some portion of exceptional desert country to be traversed.

fresh-water lakes, abound in fine, large trout, and Carson Lake in fish of a smaller kind. Great Salt Lake, according to Stansbury, contains 20 per cent. of pure salt.[1]

The principal rivers, which, on account of their width and depth, require bridging or ferry, in their flush state, during the time of melting-snow, are the Bear, Weber, Roseaux or Malade, Jordan, Timpanogos, Spanish Fork, and Sevier Rivers, which have their sources in the Wahsatch Mountains, on the east side of the Basin, and flow into the lakes near the base of these mountains; the Mojave, Owen's, Walker's, Carson, and Truckee, or Salmon Trout Rivers, which have their sources in the Sierra Nevada, and flow into lakes at their base and sink; and the Humboldt River, which flows from east to south of west along the northern portion of the Basin and sinks. The largest of these is probably the Humboldt, about 300 miles long; and the next, Bear River, 250 miles long. The others range from about 40 to 120 miles in length. These streams vary from 50 to about 150 feet in width, and from 2 to about 15 in depth, depending upon the season and locality.

All the other streams are of small extent; and taking their rise in the many mountain ranges with which the Basin is traversed (generally from north to south), they seldom flow beyond their bases, where, in the alluvion, they sink. These streams are generally so small that you can jump across them, and seldom require bridging. The large as well as the small streams mentioned, when not brackish, not unfrequently contain trout.

The trend of the mountain ranges is almost invariably north and south, the limits of variation being between the true and magnetic north. The mountains rise quite abruptly from the plain, and from bases varying in breadth from a few miles to about twelve. These mountain ranges are so frequent and close together as to make the area between them more like valleys than plains, and the roads cross them on the average every 10 or 15 miles. In length they equal the ranges. Longitudinally they are nearly level, the inclination in portions not being perceptible; sometimes tending northward and sometimes southward, and, not unfrequently, they are made up of minor valleys, separated by small ridges or rims. In cross-section they are slightly concave.

The most massive and lofty mountains, commencing at Camp Floyd and proceeding westward, are the Oquirr, Guyot, Goshoot or Tots-arr, Un-go-we-ah, Mon-tim, Humboldt, We-ah-bah, Pe-ĕr-re-ah, and Se-day-e ranges. Of these, the Tots-arr, Un-go-we-ah, Humboldt, Pe-er-re-ah, and Se-day-e are the most massive and lofty, snow appearing in patches upon their loftiest portions the whole year round. The lengths of the ranges in some instances our explorations enabled us to determine were at least 120 miles, and they there extended into unknown regions beyond the field of our explorations. These ranges attain, in the case of Union Peak, the highest point of the Tots-arr or Goshoot range, an altitude above the plain of from 5,000 to 6,000 feet, or of from 10,000 to 11,000 feet above the sea. In the case of the Oquirr range, the highest point, Camp Floyd Peak, according to Lieutenant Putnam's measurement, by theodolite, was found to be 4,214 feet above Camp Floyd: and as this locality, by barometric measurement, is 4,860 feet above the sea, the peak referred to is 9,074 feet above the sea. The highest pass was on our return-route and through the Un-go-we-ah

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(*i*) Stansbury's report, "Salt Lake," pp. 418, 419.

range. By barometric measurement it was 8,140 feet above the sea. The passes are all, with but little difficulty, surmountable by wagons; but their grades, given in Appendix F, and also on the profiles of the routes, Appendix E, will show, I think, that as railroad routes they are impracticable, except (in comparison with other probably attainable routes) at an inadmissible cost.

The chief agricultural characteristic of the country traversed is desert, the exceptions being as follows: On my more northern route, in the case of the large valleys between the mountain ranges, going westward from Camp Floyd: Rush Valley, Pleasant Valley (the valley of Fish or Deep Creek, not on the route, but in vicinity of Pleasant Valley), Ruby Valley, Walker's Valley, and Carson Valley—all these are cultivable in limited portions; and on my return route, going eastward from Genoa, Carson Valley (common to outward routes), Steptoe Valley, Antelope Valley, and Crosman Valley. The elevation of all these valleys above the sea varies from 3,840 feet, the lowest depression of Carson Valley, to 6,146 feet, the altitude of Steptoe Valley. For a particular description of these and their capabilities, I refer to my journal at the proper dates. Carson Valley has already shown its capacity to grow the small cereals and garden vegetables; and, I doubt not, the other valleys named, though higher in altitude, will be found sufficiently warm to mature the growth of the more hardy cereals, plants, and roots. It will be noticed, by reference to the journal, that my return or more southern route, though 27 miles longer than my outward, with the cut-off made on my return, is much the best, in respect to cultivable valleys and grass, and also timber. The other exceptions to the desert character of the Basin are the small, narrow valleys and ravines of the mountain streams, which, taking their rise high up in the mountains, course down to the plains or main valleys and sink. These valleys, though rich, are generally too high in altitude, and therefore too cold for arable purposes, but are of great value in furnishing, in great abundance, the small mountain bunch-grass, which has fattening qualities almost, if not quite, equal to oats.

Another exception to the universal characteristic of desert is the abundance of the dwarf cedar, which is to be seen on almost every one of the mountain ridges, and which high up in the mountains is not unfrequently intermingled with the pine, piñon balsam, quaking ash, and mountain mahogany. The abundance of this cedar, as well as occasional supply of other kinds of timber, will make either of my routes, independent of their being the shortest across the Great Basin, particularly in connection with a direct route from Camp Floyd to Denver City by way of the Timpanogos River and Duchesne's Fork, decidedly the most practicable for the overland telegraph.

The portions of the country traversed which may be called unmitigatingly desert are, on my more northern route:—the region between Simpson's Springs, in the Champlin Mountains, and the Sulphur Springs, at the east base of the Tots-arr or Goshoot range, a distance of 80 miles, (albeit the grass and water at Fish Springs and water at Devil's Hole intervene to make the greatest distance between water and grass 48½ miles and between water 43 miles); between the west base of the Se-day-e Mountains and Carson Lake, a distance of 50 miles; (this is also mitigated by the grass and water got by digging at Middle Gate, and at Sulphur Spring,) and between Carson Lake and Walker's Rivers, a distance of 21 miles. On my return, or more southern route, between Carson River and Carson Lake, a distance of 23 miles, and between the Perry range and the Champlin Mountains, a distance of 103 miles, though Chapin's Springs and Tyler Spring, with their limited pasture-grounds and the good Indian Spring, with its small supply of water but abundance of grass and cedar, within this interval, alleviate, in a very material degree, this last stretch, and take it out of the category of continuous unmitigated desert. (See itineraries, Appendixes A and B, for particulars and directions.)

The most abundant plant in the Great Basin is the *artemisia*, or wild sage, and as it is seen almost everywhere in the valleys and on the mountains, it gives its peculiar bronze color to the general face of nature. Sometimes this all-prevailing color is modified by the more vivid green of the *Sarcobatus vermicularis*, or greasewood; sometimes by the yellowish light-green of the *Lynogris*, or rabbit-bush, both of which are found interspersed not infrequently among the *artemisia* and on the mountains, not infrequently by the dark color of the scrub cedar, and occasionally of the pine and balsam. This plant, the *artemisia*, I have seen covering probably as much as nine-tenths of the whole country intervening the east base of the Rocky Mountains (longitude 104°) and the east base of the Sierra Nevada (longitude 119° 40′), or over a breadth of more than 800 miles, beyond which, east or west, it does not grow. In the aggregate it constitutes no inconsiderable hinderance to the progress of teams over untracked virgin regions. In height it is ordinarily about 2½ feet, though I have seen it in one locality as high as 8 feet. Near the ground its trunk usually ranges in diameter from 3 to 6 inches, though I have seen it, when very luxuriant, nearly a foot. It is quite brash in fiber, and therefore easily trampled down, and the light soil admits of its being readily plucked up by the roots. On this account, and because of its rich resinous properties, it makes a very quick and acceptable fuel, and, indeed, in the main valleys and plains, where there is scarcely ever any timber, it constitutes the chief resource in this particular. It also constitutes an easy and ever available means to the Digger Indians of making for themselves circular inclosures or barriers of about four feet in height against the wind, and which, summer and winter, are their only habitations. It is also used by them to make their long line of fences, on which they hang, vertically, their nets across the paths of the rabbits, and in this way catch them. It emits, particularly when brushed by your person or trampled upon, a very strong, pungent odor, resembling both camphor and turpentine, and the atmosphere is almost constantly charged with its aroma. Indeed, the idea is ever uppermost that on account of this property it will eventually be found of value in the *materia medica* and mechanic arts. It seems to thrive best in an arid, dry climate, and its presence is a sure indication of the desert character of the soil and of its utter worthlessness for purposes of agriculture.[1]

The *Sarcobatus vermicularis*, or greasewood, is the next most abundant plant, and, like the *artemisia*, is found co-extensive with the country lying between the Rocky Mountains and the Sierra Nevada. It is sometimes found alone, but more frequently scattered among the *artemisia*, and, like it, on account of its rich carbonaceous qualities, is a very common fuel on the plains. Its height, ordinarily, is 3 to 4 feet. It

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(*l*) See scientific description of this shrub, by Dr. Geo. Engelmann, Appendix M.

seems to flourish best in a rather moist, argillaceous soil. On account of its thorny spines it is a very considerable hinderance to men and beasts wherever it has to be encountered. The wood, when dry, is very hard, and on this account is used by the Digger Indians to generate fire, in the primitive mode, by the friction of two pieces, as described under date of June 3. Its spines are also used by the Indians to barb their arrows.[m]

A third plant, which, probably, is about as abundant as the greasewood, and is co-extensive with it and the *artemisia*, is the *Lynogris*, or rabbit-bush, sketched in journal under date of May 2. In height it is generally 2½ to 5 feet, and, like the greasewood, commingles with the *artemisia*.

The rabbit is mostly found where it prevails.[m]

Another tolerably common plant, which, however, does not show itself to any considerable extent until you reach the western portion of the Great Basin, is the *Epledra peduculata*, a sketch of which is seen in journal, under date of May 27.[m]

A fourth plant, or, as it may be called, a tree, which I have never seen anywhere else than in the mountains of the Great Basin, is what the Mormons call the mountain mahogany. It is found in scattered groves, usually near the summit of the mountain-passes, and, at a distance, looks like the apple-tree, its leaf resembling somewhat that of the live-oak. It is somewhat scrubby in appearance, ramifying in several branches from the ground, and not unfrequently attains a height of from 15 to 20 feet, and an aggregate diameter, across its branches, in the tree, of 15 to 20 feet. Its wood is very hard, and is used for cogs, journals, gudgeons, &c. It is not seen in considerable quantities. (See sketch in journal, under date of May 12.)[m]

The chief complexion of the face of the country is, I have already remarked, a sort of bronze color, caused by the all-prevailing *artemisia*, which has in the map a color of this kind. Another characteristic which occasionally obtains is the white alkaline efflorescence which margins, in portions, some of the streams, such as Meadow Creek, Steptoe Creek, Reese's River, Walker's River, and which sometimes characterizes whole valleys, such as White and Alkali valleys. These streams and valleys, when seen in the distance, have all the appearance of being draped in virgin snow. The alkali, however, does not appear to affect the taste of the water of the streams mentioned, though that of the wells dug in the alkaline valleys were nauseously unpalatable. This saline efflorescence is a sure poison to vegetation, and hopelessly worthless is any soil where it is seen. It is the fact, too, (and it is one of great importance in this Territory), that soils which have been originally quite productive under cultivation have, by that very process, gradually become more and more alkaline, until at length, on account of their unproductiveness from this cause, they have of necessity been abandoned. This has been the history of many a field in Great Salt Lake and Utah Valleys, and I am inclined to the belief that it will be the history of the greater portion of the cultivable land of the Territory. These soils, particularly of the valleys, on account of the streams within them having no outlets, are more or less impregnated with the salts which are brought down by the rains from the mountains, and these salts, it would seem, are gradually evolved to the surface by the process of tillage. Indeed, the truth seems to be that not only is the cultivable portion of the Territory a very inconsiderable fraction of the whole area, but even this portion is destined, in all probability, by tillage to become more and more contracted. The abandoned ruins of cities in New Mexico point, most indubitably, with their present surrounding desert wastes, to a like deterioration of soil, and such is likely to be the fate of the present cultivable portion of Utah.[o] The great staple is wheat, of which, in the valley of Great Salt Lake, I have been informed as many as seventy-five bushels have been raised to the acre. This, however, is rare. Forty bushels are more common. Oats and barley thrive; corn is raised in some of the warmer valleys, but the high altitude of the valleys generally makes the climate too cold for this cereal. Potatoes, garden vegetables, and berries do well. The peach, apricot, and melon also mature, and the apple is raised in Great Salt Lake Valley. It must be borne in mind, however, that in order to raise anything in this Territory, the land, in addition to the usual tillage, has to be irrigated. The kind of fencing used, on account of the difficulty of obtaining suitable rails, is the mud or adobe wall, which, in consequence of degradation from rains, requires extensive repairs every spring.

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[m] See scientific description, by Dr. Geo. Engelmann, Appendix M.

In regard to the resources of the Territory, agricultural, manufacturing, and personal, I refer the reader to the interesting paper from Dr. Garland Hurt, constituting Appendix N. To this should be added the arable capabilities of the valley of Green River, in the eastern portion of the Territory; of Crosman, Antelope, and Steptoe Valleys, on my more southern route; and of Walker's and Carson's Valleys, in the western portions of the Territory.

In regard to the pastoral capabilities of the Territory, I may say that they abound in a number of valleys, and on the mountains generally, the chief difficulty being the preservation of stock in the winter, which, on account of the rigor of the climate, except in the lowest and warmest valleys, or under artificial shelter, cannot endure till spring. The Government and Government contractors have in the aggregate lost, I may say, thousands of heads from this cause since the entry of the Army into the Territory in the fall of 1857.

In relation to the propriety of the term "Great Basin," as applied to this region of country, I may remark that if by it the notion is entertained that this great area is chiefly of a hydrographic character, that is filled with lakes and rivers, the idea is erroneous. Erroneous will also be the idea that, because it is called a basin, it must, as a whole, present a generally concave surface. The truth is, this is only a basin so far as that the few lakes and streams that are found within it sink within it, and have no outlet to the sea.

It may also be considered as made up of several minor or subsidiary basins, and, regarding them in succession, not in the order of magnitude, we have—

1st. Lake Sevier Basin, elevation of lowest point above the sea slightly less than 4,690 feet.

2d. Great Salt Lake Basin, elevation of lowest point above the sea, 4,170 feet.

(o) See my report of Navajo expedition, Sen. Ex. Doc. No. 64, 31st Cong., 1st sess., pp. 74 and 106.

3d. Humboldt River Basin, elevation of lowest point above the sea, near Lassen's Meadows, according to Beckwith, 4,147 feet.

4th. Carson River Basin, elevation of lowest point above the sea, at Carson Lake, 3,840 feet.

5th. Walker's River Basin, elevation of lowest point above the sea, 7 miles above Walker's Lake, 4,072 feet.

(Walker's Lake Basin estimated at about same as Carson, 3,840 feet.)

6th. Owen's Lake Basin, altitude unknown.

7th. Mojave River Basin, estimation of lowest point above the sea (Williamson), 1,111 feet.

All these valleys or sub-basins, it will be noticed, are along the outskirts of the Great Basin, just within its circumference; and as the valleys of the great central area have an average altitude of about 5,500 feet, which is, for much the larger portion of the area, about 1,500 feet higher than said basins, and for the Mojave portion over 4,000 feet higher, it will at once be apparent that, as a whole, the Basin should be conceived as an elevated central region extended over much the greater portion of the Basin, and in proximity to the circumference, sloping toward the sub-basins bordering the circumference. When this idea is entertained, and this extended central portion is in addition conceived of as being traversed by high and extensive ranges of mountains, on an average about 15 miles apart, ranging north and south, and correspondingly corrugated with intermediate valleys of commensurate lengths, and the mind conceives at the same time that the order of depression of the basins is from Lake Sevier, where it is least, around successively by Great Salt Lake, Humboldt River Valley, Carson Lake, Walker's Lake, to the valley of the Mojave, where it is much the greatest, a very good mental daguerreotype can be had of the Great Basin inside of its inclosing mountains. From this description I think it will be obvious that, while the so-called Great Basin is in some small degree a basin of lakes and streams, it is pre-eminently a basin of mountains and valleys.

In regard to the geological character of the mountains within the Great Basin, I would remark that, from Camp Floyd west, as far as about Kobah Valley, those of carboniferous origin much predominate; though over the desert proper, between Simpson's Springs and the Tots-arr range, the igneous are the characteristic; and near the Humboldt range those of Devonian age obtain. From Kobah Valley to the Sierra Nevada the ranges are almost exclusively of igneous origin, and present few indications of stratified rocks. The knowledge, geologically, of this extensive *terra incognita*, now for the first time given to the public in the reports of my assistant, Mr. Engelmann, and Mr. Meek, the paleontologist, is an interesting result of the expedition, and will go far to fill up the gap that remained to complete the geological profile of our country from the Atlantic to the Pacific, on the line of our explorations. These reports, it will be noticed, do not only discuss the geology and paleontology of the Great Basin, but of the whole route through from Fort Leavenworth to the Sierra Nevada, and to no two geologists, probably, could the work have been better assigned, since Mr. Engelmann was the geologist of Lieutenant Bryan's expedition to the Rocky Mountains in 1856, and of my expedition all the way from Fort Leavenworth to Sierra Nevada and back; and Mr. Meek's well-earned reputation as a paleontologist will certainly engage for him the attention of the scientific world. As these reports are very thorough, and include many facts of great interest to the geologist, I respectfully ask for them the perusal which their importance in reference to so great an extent of country demand.

In regard to the Indians, for a particular description of their persons and habits, I refer the reader to my journal, with its illustrations, and to the journal of Mr. Kern (Appendix Q); also the communication of Dr. Garland Hurt (Appendix O), whose residence in Utah for several years as Indian agent and well-known intelligence and character for truth and patriotism render his essay of great value. I would also refer to the communication of Maj. Frederick Dodge, Indian agent, incorporated in my journal of June 12, for information respecting the Pi-Utes and the Wa-shoes inhabiting Western Utah and Eastern California.

The Sho-sho-nees are divided by Dr. Hurt into the Snakes, Bannacks, To-si-witches, Go-sha-Utes, and Cum-um-pahs, though he afterward classes the two latter divisions as hybrid races between the Sho-sho-nees and Utahs, and this last I think the best classification.[p]

The Snakes are fierce and warlike in their habits and inhabit the country bordering on Snake River, Bear River, Green River, and as far east as Wind River. They are well supplied with horses and fire-arms, and subsist principally by hunting. They are the enemies of the Crows and Blackfeet on account of the buffalo having disappeared from their country west of the Rocky Mountains and their being obliged from necessity to hunt them as trespassers on the territory of these tribes east of the mountains. They have also been at war with the Utes for several generations. They, however, profess friendship for the whites, and it is their boast that, under their chief, *Wash-i-kee*, the blood of the white man has never stained their soil. It is certain, however, that small parties of this band, living in Box Elder County, in the Territory, with some Bannack Indians from Oregon, robbed, during the season of 1859, three parties of emigrants on the emigration road to the north and east of Great Salt Lake, and killed ten or twelve of their number.[q]

The Bannacks inhabit the southern borders of Oregon along the old Humboldt

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[p] Dr. I. Forney, superintendent of Indian affairs in Utah, classes and numbers the various tribes and bands of Indians in Utah as follows:

Sho-sho-nees, or Snakes	4,500
Bannacks	500
Uinta Utes	1,000
Spanish Fork and San Pete farms	900
Pah-Vants (Utes)	700
Pey-utes (South)	2,200
Pey-utes (West)	6,000
Elk Mountain Utes	2,000
Wa-sho of Honey Lake	700
	18,500

The Sho-sho-nees claim the northeastern portion of the Territory for about four hundred miles west, and from one hundred to one hundred and twenty-five miles south from the Oregon line. The Utes claim the balance of the Territory. (See Pres. Mes. and Doc., 1859-'60, part 1, p. 733.)

[q] See report of General Johnston to headquarters of the Army, of November 2, 1859; Supt. I. Forney's letter to Major Porter, of September 22; and Maj. I. Lynde's report to General Johnston, of October 24, accompanying Annual Report of Secretary of War for 1859.

River emigrant-road, and have the reputation of infesting the emigration along that portion of the route, and of being of a very thievish, treacherous character.

The To-sa-witches, or White Knives, inhabit the region along the Humboldt River, and, according to Dr. Hurt, have the character of being very treacherous. We met them ranging in small parties between the Un-go-we-ah Range and Cooper's Range, on our more northern route. The Ute tribe Dr. Hurt divides into the Pah-Utes, Tamp-Pah-Utes, Cheveriches, Pah-vants, San Pitches, and Py-eeds.

The Utahs proper inhabit the waters of Green River south of Green River Mountains, the Grand River and its tributaries, and as far south as the Navajo Country. They also claim the country bordering on Utah Lake and as far south as the Sevier Lake as theirs. They are a brave race, and subist principally by hunting. The buffalo having left their country and gone east over the Rocky Mountains, their hunting this game in the country of the Arrapahoes and Cheyennes brings them in continual conflict. Dr. Hurt says it is his opinion, from a familiar acquaintance with them, that there is not a braver tribe to be found among the aborigines of America than the Utahs; none warmer in their attachments, less relenting in their hatred, or more capable of treachery. Their present chief is *Arrapene*, Indian name Sin-ne-roach,[r] the successor of the renowned *Wacca*, sometimes erroneously called Walker. Some of the weaker bands both of the Snakes and Utahs are almost continually in a state of starvation, and are compelled to resort almost exclusively to small animals, roots, grass, seed, and insects for subsistence. The General Government has opened farms for these Indians in the valleys of the Spanish Fork and San Pete.

The Pah-vants occupy the Corn Creek, Paravan and Beaver Valleys, and the valley of the Sevier. On Corn Creek they have a farm under the supervision of the General Government. It was a portion of this tribe that massacred Captain Gunnison and a portion of his party. Their chief is Kan-nash.

The Pi-eeds live adjoining the Pah-vants down to the Santa Clara, and are represented as the most timid and dejected of all the Utah bands. They barter their children to the Utes proper for a few trinkets or bits of clothing, by whom they are again sold to the Navajos for blankets, &c. They indulge in a rude kind of agriculture, which they probably derived from the old Spanish jesuits. Their productions are corn, beans, and squashes. The Mountain Meadow massacre is ascribed by the Mormons to them, but, as Dr. Hurt justly remarks, "any one at all acquainted with them must perceive at once how utterly absurd and impossible it is for such a report to be true". Indeed the report of Mr. I. Forney, the superintendent of Indians in Utah, of September 29, 1859, fixes the stigma of this horrible outrage on the Mormons.[s] Their chiefs are Quanarrah and Tatsigobbets.

The Goshoots Dr. Hurt classes, as I have remarked, among the Sho-sho-nees; but, according to Mr. George W. Bean, my guide in the fall of 1858, and who has

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(*r*) This chief, according to the newspapers, has recently died.

(*s*) The Commissioner of Indian Affairs, A. B. Greenwood, in his report of November 26, 1859, to Secretary of the Interior, says, in relation to this matter:

"Many of the numerous depredations upon the immigrants have doubtless been committed by them in consequence of their destitute and desperate condition. They have, at times, been compelled either to steal or starve; but there is reason to apprehend that in their forays they have often been only the tools of lawless whites residing in the lived in Utah for the last ten or twelve years, and been frequently employed as interpreter among the Indians, they are an offshoot from the Ute Indians, and are the offspring of a disaffected portion of this tribe, that left their nation about two generations ago, under their leader or chief *Go-ship*, and hence their name Go-ship-Utes, since contracted into Go-shutes. I am disposed, too, to believe that they are thus derived from the fact that I noticed among them several Utes who, while claiming that they belonged to the Utes proper, yet had intermarried with and were living among them.

These Goshoots are few in number, not more than probably 200 or 300, and reside principally in the grassy valleys west of Great Salt Lake, along and in the vicinity of my roads as far as the Un-go-we-ah range. They are of the very lowest type of mankind, and illustrate very forcibly the truth which the great physicist of our country, Prof. Arnold Guyot, of Princeton College, has brought out so significantly in his admirable work, "Earth and Man," to wit: "*That the contour, relief, and relative position of the crust of the earth is intimately connected with the development of man.*" These Indians live in a barren and, in winter, on account of its altitude, a cold climate, and the consequence is that they are obliged to live entirely on rabbits, rats, lizards, snakes, insects, rushes, roots, grass-seeds, &c. They are more filthy than beasts, and live in habitations which, summer and winter, are nothing more than circular inclosures about three feet high, made of the *artemisia* or sage-bush or branches of the cedar, thrown around in the circumference of a circle, and which serve only to break off the wind. As the thermometer in the winter must at times be as low as zero, and there must fall a good deal of snow, it will readily be perceived that they must suffer a great deal. Anything like an inclosed lodge or wick-e-up of any sort I did not see among them. Their dress, summer and winter, is a rabbit skin tunic or cape, which comes down to just below the knee, and seldom have they leggins or moccasins.[t]

Territory. In some of the worst outrages of this kind, involving the lives as well as the property of our emigrants, the latter are known to have participated. That this was the case in the atrocious and dreadful massacre at 'Mountain Meadow,' in September, 1857, the facts stated in the report of the superintendent, in regard to that occurrence, leave no room for doubt. The lives of from one hundred and fifteen to one hundred and twenty peaceable emigrants, of all ages and both sexes, were inhumanly and brutally sacrificed on that occasion, some young children only being spared." (See "Message and Doc., 1859-'60, pp. 386 and 737-740.")

(*t*) WASHINGTON, *June* 14, 1860.

DEAR SIR: Permit me to bring to your knowledge as a fact, which it is pleasing to me to inform you, that I have in my exploration across the continent given to a very conspicuous range of mountains over which I passed the name of your worthy self, by which I feel that I not more honor a distinguished votary of physical science than I do honor to myself. Surely one who has spoken so modestly, so adoringly, so well of nature as the handiwork of the great I AM and has shown that she and history are but the counterparts of each other, both illustrating and developing the Great Intelligent First Cause and His goodness in thus "arranging all things for the education of man and the realization of the plans of His mercy," deserves this small tribute of respect and praise; and I bestow it, as I have said, feeling that I not more do honor to a great physicist than I honor myself.

The range of mountains which, on my forthcoming map, I have given the name of Guyot range, is a very conspicuous one, trending north and south, and stretching from the southern shore of Great Salt Lake well on toward the Sevier River. It lies about thirty-five miles west of the valley of the Jordan and of Lake Utah. The pass through it which my routes to California from Camp Floyd take is a fine one, and I have, with his permission, called it after General A. S. Johnston, the distinguished officer of the Army who has recently been in command of the forces in Utah. Its altitude above the sea is 6,227 feet. That of the highest peaks of the range is probably about 2,000 feet higher.

My maps, profiles, and report are nearly finished, but not sufficiently so to be presented to Congress for publication at its present session.

I inclose a paper read before the Academy of Natural Sciences of Philadelphia, anticipatory of my more elaborate report in reference to the paleontological collection of my expedition. This may soon be followed up with a publication

Between the Cooper range and the Pe-er-re-ah range we found along our routes a number of the Digger tribe, who said that they were of Sho-sho-nee origin, but had no chief. They live scatteredly, and, like the Go-shoot, are of a low type, and live and dress in the same way. Like them, their bow, arrow, ratsticks, traps, and nets are their principal instruments of subsistence. They place great value on a pair of moccasins, as they are of great service in enabling them to tramp through the sharp sage bush. They appear to be very few in number, and, like the Go-shoots, are to be little feared by an emigrant party, who are at all on their guard, against theft and treachery.

The Py-utes (according to Major Dodge) number between 6,000 and 7,000 souls. They inhabit Western Utah from Oregon to New Mexico, their locations being generally in the vicinity of the principal rivers and lakes of the Great Basin, viz: Humboldt, Carson, Walker, Truckee, Owen's, Pyramid, and Mono. They resemble in appearance, manner, and customs the Delawares on our Missouri frontier, and with judicious management and assistance from Government would in three years equal them in agriculture. Their chief is Wan-muc-ca (The Giver), and it was a portion of this tribe under this chief who have been engaged recently in the massacre in Western Utah. Their language resembles in some of its words the Sho-sho-nee (see Appendix J), yet it differs so much from it that my guide, Ute Pete, who spoke both Ute and

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by the same society of some extracts from my report, which will be more particularly descriptive of the new species of fossils which were found.

My report I think, among other things, will illustrate, in the low type of man to be found in the Indians of the "Great Basin" of our continent, called "Root Diggers," how intimately connected with the contour, relief, and relative position of the crust of the earth is the development of the human race, and will add one more to the many facts which you have given in your "Earth and Man" of this important geographical truth.

Permit me to subscribe myself, very respectfully and truly, yours,

J. H. SIMPSON,
Captain Topographical Engineers.

To Prof. ARNOLD GUYOT, LL.D.,
Princeton, N. J.

PRINCETON, N. J., *June* 20, 1860.

DEAR SIR: I have the honor to acknowledge the receipt of your most acceptable letter, and I thank you very heartily for the kind feeling expressed in it. Guyot range of mountains will recall to my mind more than a lofty mountain chain; it will tell me of the sympathy that truths dear to me, because fruitful of much good and enjoyment for me and for many others, have found with you. Believe me, dear sir, when I say that I feel particularly gratified to find a man of your busy profession and of your attainments so well acquainted with, and so appreciative of, the views so briefly exposed in the little volume to which you allude in so kind terms. Common convictions and a common faith on such grand topics are a bond of union among men which cannot easily be broken. So I shall now feel when thinking of you.

I have read with great interest the geological notice of Messrs. Meek and Englemann on your geological discoveries. The presence of all the great geological formations, from the Silurian and Devonian up to the Tertiary, in the Great Basin, and also the circumstance of the Paleozoic rocks constituting the chief formations west of the Salt Lake, are data which throw much light on the geological history of this country.

I shall look with eagerness to your coming report for more light still on these regions so long unknown; and I am very glad that you did not forget the study of the poor human beings who were the first tenants of these wildernesses. and of the influence that the niggard nature amidst which their lot is cast had on shaping their present condition.

I remain, my dear sir, with great regard and very truly, yours,

A. GUYOT.

To Capt. J. H. SIMPSON,
Topographical Engineers, United States Army.

Sho-sho-nee, could not understand them.[u] This tribe is frequently confounded with the Pah-Utes, with which they show only a distant affinity.

The Washoes, according to Major Dodge, "number about 900 souls, and inhabit the country along the eastern slope of the Sierra Nevada, from Honey Lake on the north to the Rio Clara, the west branch of the Walker's River, a distance of 150 miles. They are not inclined to agricultural pursuits nor any other advancement toward civilization. They are destitute of all the necessaries to make life even desirable. There is not one horse, pony, or mule in the nation. They are peaceable, but indolent. In the summer they wander around the shores of Lake Bigler, in the Sierra Nevada, principally subsisting on the fish found in it. In the winter they lay about in the *artemisia* of their different localities, subsisting on a little grass-seed." The Indian vocabulary (Appendix J) will show that they are a distinct tribe, and in no way assimilated with the Utes, Sho-sho-nees, or Py-Utes.

The Indians living along or in the vicinity of my routes are, as above stated, starting from Camp Floyd, first, the Go-shoots, as far as the Un-go-we-ah range; second, the Humboldt Indians, from the Un-go-we-ah range to Cooper's range; third, the Diggers or Pah-Utes, who are of Sho-sho-nee origin, from Cooper's range to the Pe-er-re-ah range; fourth, the Pi-Utes, from the Pe-er-re-ah range to the Sierra Nevada; and, fifth, the Washoes, at the base of the Sierra Nevada. All these Indians, as they seldom carry any weapons but the bow and arrow, will be found perfectly harmless to parties of emigrants who are tolerably well armed and sufficiently on the alert not to invite attacks or theft. In our case, as a general thing, it was as much as we could do to get them to visit us at all, their fright was so great. Indeed, never do emigrants meet with any difficulty from Indians passing over the plains, when they observe but ordinary vigilance and care.[v]

(*u*.) Mr. J. Forney, superintendent of Indians in Utah, in his report of September 29, 1859, to the Secretary of the Interior (Mess. and Doc., 1859–'60, p. 732), speaking of these Indians, says, "the Utah-Pah-Vant and Py-Ute, although they are designated by several different names, yet all have emanated from one nation or tribe and speak the same language." My vocabulary (in Appendix J) will show that in this last particular he is incorrect; at least so far as the Py-Utes are concerned.

(*v*.) Major Lynde, in his report to General Johnston, of October 24, 1859, giving an account of his expedition against the Indians who had committed some massacres on the old Humboldt River road, makes the following remarks in relation to the carelessness of emigrants he met in respect to proper vigilance against Indian surprises and attacks:

"Every train that has been attacked acknowledge that they were perfectly unprepared for defense. The Indians watch the trains from the hills, and if they see a train well-armed and watchful, they do not molest it. I have seen many trains on the road during the summer which had plenty of arms, but they were carried in the wagons, and in many cases without being loaded. The emigrants would laugh at me when I told them of the necessity of always having their arms ready for instant use." (See report of Secretary of War, 1859, p. 241.)

REPORT AND JOURNAL.

REPORT AND JOURNAL.

On the 6th of January, 1859, at Camp Floyd, Utah Territory, I had the honor to submit, through General A. S. Johnston, commanding the Department of Utah, to the War Department, for its approval, the following project of exploration:

Office of Topographical Engineers, Department of Utah,
Camp Floyd, Utah Territory, January 6, 1859.

Sir: Agreeably to instructions from the headquarters of this department, as you are aware, a new route has been opened from Fort Bridger to this post, by the way of Timpanogos River Valley, which, in connection with Lieutenant Bryan's route, or even by the old South Pass road, makes an excellent link in the chain of routes from the States to this post. There has also been explored, by direction of the commanding general, and is now in use by the United States as a postal route, a route west of this post across the Great Salt Lake Desert, which has been extended by the mail company all the way to the Humboldt, and which they report as promising a hard wagon-road, with a sufficiency of fuel, water, and grass. These improvements in the old route have already been of great service to the Army and country, but it is believed that still greater can be made. It is believed that a direct route from this post to Carson Valley, in Utah, can be obtained, which would avoid the detour by the Humboldt to the right, and that by the Las Vegas and Los Angeles route to the left, and that it could be obtained so as to make the distance hence to San Francisco less than 800 miles; that is, that a route could be found in this direction 260 miles shorter than the Humboldt River route and 390 miles shorter than the Los Angeles route. To make this plain, I respectfully refer you to the accompanying extract from my report of December 28 to these headquarters, giving a detailed account of reconnaissances recently made by me under the order of the commanding general.

In this connection I would respectfully state that it is believed, also, that a still shorter and better route may be obtained from Camp Floyd to Fort Leavenworth than by either the South Pass or Lieutenant Bryan's route. I refer now to a route hence to the headwaters of the Arkansas and thence via Bent's Fort to Fort Leavenworth. This route, it will be noticed by reference to the map recently compiled in the office of explorations and surveys, promises to be at least as short as either of the others, and might prove considerably better as a wagon-route. The routes passed over by Frémont, so far as his published report informs me, as well as that of Captain Gunnison, which is too far south, I should suppose, would be impracticable for the object in view; but still it is believed that more information than when they crossed over the country is now obtainable, and it is not at all improbable that Colonel Loring, who has recently returned to Santa Fé by a new route, and has reported his trip as successful, may be enabled to give important information in the matter.* I would, therefore, respectfully report, as a project of reconnaissance for the present year, to be commenced as soon as the season will permit, an exploration hence to Carson Valley, there to connect properly with a known route; a return exploration thence to this post for a further improvement of the route; the party to be here refitted and to explore a new route hence to Fort Leavenworth by way of the sources of the Arkansas and Bent's Fort; the report and maps to be made up in Washington. I would require an assistant, which might be Lieutenant Putnam, Topographical Engineers, as he is junior to Lieut. J. L. K. Smith, and in order to the facilitation of the survey, and the insurance of its success, an escort such as the commanding general might deem advisable.

I respectfully submit this project to the consideration of the commanding general, in order, if it is approved, it may be referred, through the Bureau of the Topographical Engineers, to the Hon. Secretary of War for his sanction.

I am, sir, very respectfully, your obedient servant,

J. H. Simpson,
Captain Corps of Topographical Engineers.

Bvt. Maj. Fitz John Porter,
Assistant Adjutant-General.

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*At the time of writing the above it was believed that Colonel Loring had returned to Santa Fé by a new route, but I find on looking at the map of his route, since received, that he took mainly Captain Gunnison's route of 1853.

The project was approved by General Johnston and met with the sanction of the Secretary of War, as follows:

BUREAU OF TOPOGRAPHICAL ENGINEERS,
Washington, February 17, 1859.

SIR: Your letter of 6th ultimo, inclosing a project of exploration for the present year, approved by the commanding general of the department, having been submitted to the Hon. Secretary of War, has been returned with the following indorsement:

"WAR DEPARTMENT, *February* 16, 1859.

"Approved.

"J. B. FLOYD,
"*Secretary of War.*"

Respectfully, sir, your obedient servant,

I. C. WOODRUFF,
Captain Topographical Engineers, Assistant to Bureau, in Charge.

Capt. J. H. SIMPSON,
Corps Topographical Engineers, Camp Floyd, Utah Territory.

In accordance with the foregoing authority, the following orders were issued from the headquarters of the Department of Utah:

HEADQUARTERS DEPARTMENT OF UTAH,
Camp Floyd, Utah Territory, April 26, 1859.

SIR: Under authority from the Secretary of War, bearing date December 18, 1858, and February 16, 1859, Brigadier-General Johnston directs you to renew, as soon as the season will permit, the exploration commenced under his instructions of 15th October ultimo, and which was brought to a close by the rapid approach of winter; and also to arrange for an examination of the country hence to the Arkansas, in accordance with your project of January 6, 1859.

The general directs me to address you as follows, as a recapitulation of the duties assigned to you:

First. To explore south of the Great Desert, in order to ascertain the practicability and economy of locating and working, for military purposes and for general traveling, a wagon-road hence to Carson Valley, and there to connect with a known route across the Sierra Nevada; returning, to explore for an improvement in that route, or, should that not be feasible, for an improvement in the new route from the Humboldt to this post.

Second. To examine for a new route hence to Fort Leavenworth by the way of the sources of the Arkansas and Bent's Fort.

In connection with obtaining geological and botanical information of the country, your attention is specially called to determining the quality and extent of the grass, building-materials, and fuel at positions suitable for the location of a military post, it being understood by suitable positions those in or near the Indian country, having, in addition to easy access to and control over the avenues of communication, the three essentials, fuel, water, and grass.

It is desirable, from its military importance, to procure information of the number and size of the Indian tribes through which you will pass, the extent of the country of each, their mode of living, carrying on war, how armed, &c

On your return to this camp, while waiting the refitting of your party, you will, as connected with your second expedition, make an examination to the sources of White River, (western branch of Green River,) passing up both the Timpanogos and Spanish Forks.

Whichever route, Colonel Loring's trail through San Pete Valley or one of the above, indicates most favorably for making a short and feasible road, that one will be taken to White River, whence Colonel Loring's trail will be followed and improved to and up Grand River, and thence through the Cochatope Pass to Fort Garland, Sangrede Christo Pass, down the Huerfano, to the Arkansas, &c., to Fort Leavenworth.

Should you find it advisable to examine from the Cochatope Pass or its vicinity direct to the Arkansas, you are authorized to do so; but if a route in that direction be not economically practicable, you will return and renew the examination of the route above indicated.

From Fort Leavenworth, with the assistants necessary to make up your work, you will repair to Washington and report to the Adjutant-General.

To enable you to perform these duties, you will take with you all your party, civil and military, and be furnished with an escort on your first expedition of one officer and twenty men (ten mounted) and a guide and interpreter. A new escort will be provided on your return to this camp.

The commanding general wishes a report of your progress and success from time to time, as occasion may offer. Should there be any change in your instructions, they will be found at Genoa or on your return to this camp.

I am, sir, very respectfully, your obedient servant,

F. J. PORTER,
Assistant Adjutant-General.

To Capt. JAMES H. SIMPSON,
Topographical Engineers, Camp Floyd, Utah Territory.

HEADQUARTERS DEPARTMENT OF UTAH,
Camp Floyd, Utah Territory, April 25, 1859.

SPECIAL ORDERS, No. 31.

An escort of one officer and twenty men (ten mounted and ten foot) from Camp Floyd will be furnished Capt. James H. Simpson, Topographical Engineers, charged, under the authority of the Secretary of War, with an exploration for military purposes of the country hence direct to Carson Valley.

The officer will furnish such aid and assistance to Captain Simpson as will facilitate his operations, and will act as assistant quartermaster and commissary to the command.

A medical officer will be assigned to the command.

By order of Bvt. Brig. Gen. A. S. Johnston.

F. J. PORTER,
Assistant Adjutant-General.

HEADQUARTERS CAMP FLOYD, *April* 26, 1859.

SPECIAL ORDERS, No. 110.

Pursuant to Special Orders No. 31, from the headquarters of the Department of Utah, dated on the 25th instant, the following party is detailed to accompany Captain Simpson, Topographical Engineers, who has been ordered on a tour of exploration for military purposes, as an escort to and from Carson Valley, Utah Territory:

Second Lieut. Alexander Murry, one sergeant and one corporal, and eight privates, Tenth Infantry; two non-commissioned officers and eight privates, well mounted, Second Dragoons.

Lieutenant Murry will consult with Captain Simpson immediately in regard to their transportation and supplies for the party. Seventy rounds of ammunition will be taken.

Assistant Surgeon Joseph C. Bailey will accompany the expedition.

By order of Bvt. Col. C. F. Smith:

CLARENCE E. BENNETT,
Second Lieutenant and Adjutant Tenth Infantry, Post Adjutant.

Pursuant to the foregoing, the following orders were issued by me to my party:

[Orders No. 1]

OFFICE TOPOGRAPHICAL ENGINEERS, DEPARTMENT OF UTAH,
Camp Floyd, Utah Territory, April 29, 1859.

Agreeably to orders emanating from this department of April 25 and 26, the topographical engineer party under the command of the undersigned will leave the post early on the morning of the 2d proximo, for the purpose of exploring a new route to California.

To Lieut. J. L. K. Smith, topographical engineers, is assigned the duty of taking sextant observations for latitude and time or longitude. These observations will be made at every camp, and those on the sun will be preferred. Equal altitudes of the sun every twenty-four hours will be made, either when practicable on the same day, or, which will generally be the case, in the afternoon of one day and, when the sun is at corresponding altitudes, the next morning. Observations on east and west stars will be made when, on account of unfavorable weather, the sun cannot be observed.*

To Lieut. H. S. Putnam, topographical engineers, is assigned the duty of making the proper magnetic observations for dip, intensity, and declination of the needle. In addition to those for declination with the magnetometer, which will be taken at least within every fifty miles, he will also observe on Polaris for the same purpose, the epoch being when it is at either of its culminations or greatest eastern or western elongation, when the reading of the needle of the theodolite or compass will be noted.

To Lieutenant Putnam is also assigned the duty of observing with the astronomical transit, at the proper epochs, the moon and moon-culminating stars for longitude. Observations for lunar distances, and altitudes will be also observed for the same purpose, the three sextants being used at the same time by as many observers.

To Lieutenant Putnam is further assigned the duty of surveying the route by noting, in a proper manner, the bearings and distances of the various deflections of the route and of the topographical features of the country within the limits of vision. These notes will be plotted every evening, and thus our exact position from day to day shown.

Lieutenant Putnam will further keep up an itinerary of the route, according to the prescribed form with which he will be furnished, the distance to be measured by two odometers to provide against error.

To Mr. Henry Engelmann, geologist, is assigned the duty of observing the country passed through geologically and botanically, specimens in each department being collected for this purpose and properly labeled and packed away.

Mr. Engelmann will also take charge of the barometrical and meteorological observations, the object being to obtain an exact profile of the route as well as a knowledge of the climate and its relation to the physical aspects of the region traversed.

Messrs. Edward Jagiello and William Lee will assist the above-named officers in the required observations in the mode which may be found most expedient.

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* These last observations were most resorted to on the expedition on account of being generally practicable.

To Mr. Charles McCarthy is assigned the duty of taxidermist and collector of specimens illustrative of the animal and insect world. In order to this, he will be assiduous in the collection of the necessary proportion of specimens, and in their being properly prepared for preservation and transportation.

To Mr. H. V. A. Von Beckh is assigned the duty of sketching the country in a manner to illustrate its common as well as peculiar characteristics.

The escort, under the orders from the Department of Utah, will be commanded by Lieut. Alexander Murry, Tenth Infantry, who has also been charged with the duties of quartermaster and commissary, and directed to see that the expedition is supplied with everything in these departments, according to the requisitions which have been approved by the proper authority.

Lieut. J. L. K. Smith will act as ordnance officer, and will obtain from the Ordnance Department the necessary arms and ammunition for the party.

The expedition we are about to enter upon being an important one, it is expected by the officer commanding that each and every officer, soldier, and citizen engaged in it will do his utmost to secure its success.

J. H. SIMPSON,
Captain Corps Topographical Engineers, in Charge of Expedition.

Camp Floyd, May 2, 1859.—Longitude, 112° 8′ 7″; latitude, 40° 13′ 18″; elevation above the sea, 4,860 feet; magnetic variation, 17° 10′ 8″ E. The topographical party under my command left this post at a quarter of 8 a. m., to explore the country intervening this locality and Carson River, at the east foot of the Sierra Nevada, for a new and direct route to California.

My orders of the 29th ultimo show who my assistants are, and their several vocations. The employés of the party number nine persons, and make the total number of the topographical party, inclusive of assistants, one guide, two Mexican packers, and two Indians of the Ute tribe, twenty-two.

The escort is composed agreeably to post orders No. 110, above given, and aggregates, rank and file, twenty-two persons.

We have with us twelve six-mule quartermaster-wagons, for the transportation of supplies, three more loaded with forage, for the first five or six days, and one six-mule and one four-mule ambulance, for the conveyance of the instruments. We are rationed for three months, six commissary beeves being driven on foot. The wagons were all parked yesterday for inspection preparatory to being turned over to us by the depot quartermaster, and what parts were found defective supplied by others. The number of teamsters is fourteen, exclusive of the three belonging to the forage-wagons, which are to return to Camp Floyd, and Mr. Henry Sailing is the wagon-master. We have also with us one wheelwright, one blacksmith, and four herders, making the aggregate number of the topographical party, escort, and quartermaster's employés sixty-four. Included in the number is a commissary sergeant (Miller, Tenth Infantry), and Private Thatcher, Tenth Infantry, hospital steward and acting bugler.

The topographical party and teamsters are provided each with a navy-revolver. Of course, the military escort has its proper arms.

Our instruments are, three sextants, three artificial horizons, one astronomical transit, four chronometers (one large box and three pocket), two cistern-barometers, one magnetic dip-circle, or inclinometer, and one magnetometer. This last is the instrument which Dr. Kane had with him on his polar expedition, and has all the dingy, worn appearance which such an expedition would naturally cause. We have also a number of Schmalkalder, or prismatic, and pocket compasses.

The route we take is that I explored last fall on my return from Short Cut Pass, of Colonel Thomas' range, a report and map of which have already been rendered and, by order of Congress, published.* Our course lay slightly south of west, up a scarcely perceptible ascent, out from Cedar Valley to Camp Floyd Pass (altitude, 5,234 feet above the sea), 3 miles distant from Camp Floyd; through this broad champaign pass 3 miles, and thence, nearly southwest, 12.2 miles, to Meadow Creek, in Rush Valley, where we encamped. Journey, 18.2 miles. Road good.

Finding that the California mail party, after threading Camp Floyd Pass, had missed my route of last fall, and had unnecessarily made too great a detour to the northward, I struck directly across to Meadow Creek with the wagons, and thus marked out a short cut which would shorten the road a mile or two.

For the conformation of Cedar Valley, in which Camp Floyd is situated, and of Rush Valley, in which we are encamped, and of the mountains limiting them, see map herewith.

These valleys are slightly concave in cross-section east and west, Cedar Valley averaging a breadth of 8 miles and Rush Valley a breadth of 13 miles, and lie longitudinally north and south, Cedar Valley, for a length of 30 miles, and Rush Valley, for a length of 40 miles, and give evidence, from the appearances of water-lines along the base of the mountains, that they were once submerged, and doubtless a part of the Great Salt Lake. The whole of Cedar Valley has been reserved by the General Government for military purposes, and at the northern portion of Rush Valley, is the small military reserve laid out by directions of Lieutenant-Colonel Steptoe in 1855.

The soil is argillo-calcareo-arenaceous in character, has a sort of buff color, and quickly absorbs the rains, which seldom fall in this region except in the fall, winter, and spring. The vegetable growth is principally the *artemisia tridentata*, or wild sage, with the *sarcobatus vermicularis*, or greasewood, and the *lynosyris*, or rabbit-bush, intermingled.

These valleys are very sparsely watered, and though the soil in itself has all the elements of fertility, yet for want of the necessary moisture, for agricultural purposes, except in a small number of areas containing but a few acres which can be irrigated, it is utterly worthless. The cultivable portions in Cedar Valley are at Cedar Fort, a Mormon settlement, 5 miles north of Camp Floyd, and at Camp Floyd, and in Rush Valley, at Johnson's Settlement, on Clover Creek, in the northwestern portion of the valley, where there are about 200 acres of good farming land. Not a tree is to be seen anywhere in either of the valleys, though scrub-cedar and pine crown the mountain-heights. There is quite an abundance of good grass upon the bases of the mountains and in the cañons, and in some places it is to be found in patches in the valley. It is also found along Meadow Creek, in Rush Valley, and along other short streams in the southwestern portion of this valley. Indeed, both in the southwestern and northern portions of this valley there is a great deal of excellent grass, and the Government herds of beef-cattle and mules were wintered at these points during the past winter. The pasture on Meadow Creek is slightly alkaline.

The mountains limiting the valley are at points quite formidable, the Oquirrh range dividing Cedar and Rush Valleys discovering along its crest in midsummer shreds of snow which the sun has not been able to dissipate. The highest point of this range, which I call Camp Floyd Peak, on account of its proximity to the post of that name, is 4,214 feet above the camp, or 9,074 feet above the sea. The formation of these mountains is made up of highly siliceous altered limestones, slate-rock, and altered sandstones (quartzite) of the Carboniferous period, the slaty, calcareous rocks predominating.

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* Sen. Ex. Doc. No. 40, 35th Cong., 2d sess.

The roads in these valleys are good and lead out in various directions into the adjoining valleys.

The weather has been pleasantly warm. For exact state of it to-day and succeeding days, see meteorological diary, Appendix U.

May 3, *Camp No.* 1, *on Meadow Creek.*—Elevation above the sea, 5,205 feet. The bugle sounded reveille at daybreak. Thermometer at 5 a. m., 39°. Moved at 6 a. m. Follow up Meadow Creek a mile, and then cross just above old adobe corral. Crossing only tolerable. This stream, which is of gentle current, is so narrow that you can jump across it, and is but a few inches in depth. It runs northerly about ten miles and sinks. About a half mile above the crossing the mail company has a station, at present consisting of a Sibley tent, and a cedar-picket corral for stock is being made. From this station our course lay nearly southwest, seven miles to east, foot of General Johnston's Pass, which I discovered last fall, and which I called after the general commanding the Department of Utah. The mountain range, which is quite a formidable one, I call after Prof. Arnold Guyot, LL. D., the distinguished physicist and professor in the college of New Jersey.

In about a mile more, by a good grade, you reach the top of the pass (altitude above the sea, 6,237 feet), and thence, in three-quarters of a mile, by a steep descent, which, for a portion of the way, teams going east would have to double up, you attain to a spot where is a patch of grass, and where we encamped. There is a small spring near us, on the north side of the pass, which, however, our animals soon drank dry, and which doubtless is dry during the summer. Road to-day good. Journey, 9.9 miles, reaching camp a little after meridian.

The Ute Indian, brother of Arrapene, chief of the tribe, who accompanied us as guide, reporting himself too sick to go on with the party, I permitted him to return to Camp Floyd. Saw two antelope, a couple of sage hens, and McCarthy shot a curlew, from which he took, perfectly formed in the shell, an egg as large as a chicken's. The California mail-stage passed us on its way to Camp Floyd. Cho-kup, chief of the Ruby Valley band of Sho-sho-nees, was a passenger, on his way to see the Indian agent. He is the best-looking Indian I have seen in the Territory.

Near our camp, Russell, Major & Waddel have a herd-camp. The herds find excellent and abundant pasture on both sides of this range of mountains, a few miles to the south, in Rush and also in Porter Valley. Water also abundant at these points.

The summits of the highest mountains have still their wintry garb of snow upon them. Last winter was an unusually severe one, and the consequence is that the spring has been backward, and the grass is yet quite short and tender; though on the mountain slopes and in the gorges it is sufficiently advanced for grazing.

May 4, *Camp No.* 2, *three-quarters of a mile below summit of General Johnston's Pass.*—

Elevation above the sea, 5,816 feet. This morning at daylight we found that a driving snow-storm had set in from the west and about six inches of snow had fallen. The Sibley tent occupied by some of the assistants had become prostrated, under the combined effects of the snow and wind, and when I saw it its occupants were still under it. Lieutenant Murry reports the spring full again this morning. Thermometer at 5½ a. m., 32½°.

Moved camp at 10 minutes after 7 a. m., our course being westwardly down General Johnston's Pass into Skull Valley (altitude, 4,850 feet above the sea), and thence southwestwardly, in a somewhat tortuous direction to avoid a low mountain, to a spring which I discovered last fall, and which I called, in my last report, Pleasant Spring, but which now, I find, goes by the name of Simpson's Spring. This spring is on the base and north side of some mountains, which I call after Captain Stephen Champlin, of the United States Navy.

Journey, 16.2 miles. Road good.

We are now on the southern side of the Great Salt Lake Desert, which extends, with an occasional interruption from small isolated mountains, all the way to the most northern portion of the Great Salt Lake, a distance of over 100 miles. The whole scene is that of a somber, dreary waste, where neither man nor beast can live for want of the necessary food and water, and over which a bird is scarcely ever seen to fly. The surface is singularly flat, a very slight downward grade, however, being observable northwardly toward the lake. The soil is argillo-calcareo-arenaceous, and produces only a small growth of *artemisia* and greasewood. As you approach Great Salt Lake the ground becomes more level and low, and the valley presents the appearance of a mud-flat, which, in some localities, is covered with an incrustation of common salt, and over which it would be hazardous for wagons to cross. Captain Stansbury, in his report of March 10, 1852, very justly remarks that "these plains are but little elevated above the present level of the lake, and have, beyond question, at one time, formed part of it." Indeed, the water lines indicate, as in Rush and Cedar Valleys, that the whole desert has at one time been submerged, and constituted a part of the Great Salt Lake. Captain Beckwith, in his report of November 25, 1854, speaking of the portion of the desert over which he passed, to the northward of our route, says: "Five miles from Granite Mountain we left the dry soil on which we terminated our march last evening, and passing over a narrow ridge of sand, entered upon a desert of stiff mud, as level as a sheet of water, which we found great difficulty in crossing with our wagons, for 17.66 miles. For this entire distance there is not a sign of green vegetation, and only here and there a dry stalk of *artemisia*, where it has been transported by the wind. The lightest sheet of effloresced salt covered the moist earth at intervals, and the track of a single antelope or wolf could be seen crossing the desert for miles, by the line of dark mud thrown up by its feet, so level, soft, and white was the plain; and the whole scene was as barren, desolate, and dreary as can be imagined." While such was the character of the country where Captain Beckwith passed, I would remark that at the southern portion of the desert, where our route lay, the plain or valley is sufficiently high to be dry and affords a good road.

The Champlin Mountains, at the foot of which we are encamped, are composed of porphyritic and other igneous rocks, which have tilted up and much altered the stratified rocks around them, to wit, sand-rocks, siliceous limestones, and being quite high, and giving rise to springs and short running streams on their west, south, and east sides, and covered as they are with cedar and, in many places, grass, they formed a very valuable topographical feature in the line of travel over the Great Desert, as will be seen more fully in my notes of my return route. The other mountains to the north and southwest are to be seen looking dark and dreary, and indicate by their scorched, vitreous, and, in some portions, ashy hue, that they have been subjected to igneous action. Not a tree is to be seen upon them, nor a patch of green vegetation of any kind. They are fit monuments of the desolation which reigns over the whole desert.

The spring where we are encamped furnishes but a scant supply of water, which, however, the mail company, which has a station here, has collected in a reservoir formed by a dam across the ravine. The accommodations of the company are at present a Sibley tent, set upon a circular stone wall. There is an abundance of grass in the vicinity and cedar on the heights, but not conveniently near.

We found our guide, Mr. Reese, here, agreeably to appointment. I had sent him in advance of the party six days to examine the country to the south and southwest of this spring to see if the Short Cut Pass, which is objectionable on account of its high grade, 20 miles to the southwest, through Colonel Thomas's range, could not be avoided. He informed me that he has been fully 35 miles in the direction stated, and is convinced that for 60 miles there can no water be found. He has been up a cañon ten miles to the south of Simpson's Spring, in Champlin Mountains, where there is plenty of grass and water; but to go to this water now would be out of our way. It is possible, however, that on our return from Carson Valley it would be expedient for us to go directly from Short Cut Pass to the cañon referred to, and, by thus being able to get into Porter Valley, get into Rush Valley toward its south extremity, and thus reach Camp Floyd by a route which might furnish more water and grass than by our present route.

Skull Valley, which is a part of the Great Salt Lake Desert, and which we have crossed to-day, Mr. George W. Bean, my guide over this route last fall, says, derives its name from the number of skulls which have been found in it, and which have arisen from the custom of the Goshoot Indians burying their dead in springs, which they sink with stones or keep down with sticks. He says he has actually seen the Ute Indians bury their dead in this way near the town of Provo, where he resides.

May 5, *Camp No.* 3, *Simpson's Spring.*—Longitude, 112° 47′ 18″; latitude, 40° 1′ 55″; magnetic variation, 15° 30′ E.; altitude above the sea, 4,850 feet. Morning bright. Thermometer, at 5 a. m., 40°. Guide left us at half past 5, with two men and one pack-mule, to explore a pass about five miles to the northward of "Short Cut Pass," in the range beyond us, and thus, if possible, cut off a bend of the mail-route beyond "Short Cut." He is to join us to-morrow at the next watering-place. My instructions contemplated my keeping south of my old route from Simpson's Spring; but the guide finding no water in that direction, I am forced on my old route. I may be able, however, on my return, to keep more south.

My party moved at quarter to six. Course nearly southwest, across desert (altitude above the sea, 4,370 feet), thinly covered with short *artemisia*, or sage, to "Short Cut Pass," altitude above the sea, 5,347 feet, in a mountain range, which I call Colonel Thomas' range, after Lieut. Col. Lorenzo Thomas, assistant adjutant-general of the Army. Through this pass Chorpenning & Company, the mail-contractors, have made a road, but it is so crooked and steep as to scarcely permit our wagons to get up it. In other respects, road to-day good.

Encamp 1.3 miles west of summit of pass, where there is little or no grass, and no water. Journey, 23.2 miles.

At foot of pass we find a couple of men of the mail-party living in a tent. They are employed in improving the road through the pass, and digging for water. They have been digging for two weeks in different places in the vicinity, and as yet have found none. At the well, near this tent, they had got down ten feet, and came to hard rock. The dip of the rocks being decidedly to the other or west side of the range, it is more probable, if water can be found at all by digging, which I very much doubt, it would be found in that quarter. My idea has been all along that it will be found useless to dig for water in these deserts, except where there are springs, and that when water is found, it will be entirely due to them, and not to a general sub-stratum of water. At Camp Floyd, near the spring, there are several wells of water, which have been dug; but about six miles south of the post, in the valley, where General Johnston had several dug, and where there are no signs of springs, not a drop of water could be found, though the earth was penetrated to a depth of forty feet.

I examined a pass about one-half a mile to the north of Short Cut Pass, which is of good grade, and which, if the same amount of labor had been bestowed upon it as upon Short Cut Pass, would have furnished a far better road. I recommended to the mail-party a change, even now, of the road to this new pass.

A half-gallon of water per man for night and morning has been distributed to the different messes, and one-third of a gallon of water and half a ration of forage to each animal.

The solitary mountains and mountain-ranges in the desert, as I have before remarked, are of igneous origin, entirely denuded of vegetation, and look in some instances as if they have been blasted by fire. Such is the case with Colonel Thomas' range, in the pass of which we are encamped. More particularly speaking, this range is a combination of stratified and trachytic rocks, partly semi-fused stratified rocks.

May 6, Camp No. 4, Short Cut Pass.—1.3 miles west of summit; altitude above the sea, 5,005 feet. The grass at this camp being very scant, and it being important to reach water as soon as possible, the expedition, under charge of Lieutenant Murry, left at twelve midnight on its onward march, myself remaining behind with a small party to look at the country by daylight. I with my party moved at twenty-five minutes after five.

My exploration of last fall only extended from Camp Floyd as far as Short Cut Pass. Thence it is my intention to follow Chorpenning's extension of my route to Hasting's Pass, in the Humboldt Mountains, a distance of 166 miles, and at that point diverge from it more southwardly; Beckwith's, as well as Chorpenning & Company's, striking off to the Humboldt too far northwardly. All this while I shall keep the guide with a party to the south of me, examining the country in that direction along a line generally parallel to that I shall follow, so that on my return I shall, if possible, be able to open a route farther to the south, and thus obtain a better and shorter route to California.

The road we are following for one mile continues down the pass north of west, and then turns more southwardly, Thomas' range flanking us on our left, or to the east, and the desert on our right. In 6 miles you enter Cedar Valley, made by Thomas' range on your left, and a short range on your right. Threading this, in 3 miles you emerge from it, and cross a valley 9 miles wide, which, on your right, is a salt-spring marsh and boggy, and therefore forces the road to the south, as indicated on the maps. This valley crossed, the road takes a sharp turn to the right, and, running northwestwardly, skirts a range of highly-altered calcareous and slaty rocks on your left, and in 1.5 miles passes by Devil's Hole, and in 5.5 miles more reaches Fish Springs, where Lieutenant Murry and command are encamped. Whole journey, 25.3 miles. Road, though not what may be called bad, yet in some places sandy, and in others stony; soil, areno-calcareo-argillaceous, the wild sage and greasewood characterizing it; not a tree visible, except a few dwarf cedars in Cedar Valley; mountain formations metamorphic, as already stated; general dip of strata north of west, and partly decided.

The Devil's Hole is a natural well, about 15 feet in diameter, and measures 25.5 feet in depth. A whitish clay efflorescence incrusts the sides, and the water is slightly saline in taste, the horses drinking it pretty freely. In color it is greenish. The surface of the water is 10 feet below that of the ground, and therefore can be reached only with the pail.

There is a mail-station at these springs, where we are encamped. At present the only shelter is a thatched shed. The mail-agent reports that it is perfectly impracticable to shorten the route by striking directly across the valley to this station, on account of the alkaline flat, which will scarcely allow animals with packs to cross. The springs are large and copious, very clear, the bottom presenting a whitish appearance, with a hue of green. An innumerable quantity of fish are to be seen sporting in the water. We have caught some specimens. They are about 6 inches long, have darkish, speckled scales, and seem to be a kind of chub. They are very inferior for the table. The water is slightly brackish and lukewarm, but when allowed to cool is palatable.

Rained slightly in showers to-day. Grass in scant quantities along the road in places; to be found in tolerable quantity on side of a mountain near camp.

May 7, *Camp No.* 5, *Fish Springs.*—Elevation above the sea, 4,289 feet. Thermometer at 5 a. m., 40°.25. The guide did not return until this morning. He corroborates the statement of the mail-agent in respect to the impossibility of crossing the valley directly to the east of this camp, he having been obliged to unpack his animals to get over the marsh. Since yesterday morning he has traveled about 60 miles, having been incessantly going all night. He could find no water in pass to the south of Devil's Hole. A Ute Indian at the mail-station says, however, there is water there, and I have therefore instructed the guide to take the Indian with him and examine the region again in that direction. If water is found there, I shall change the road accordingly on my return from Carson Valley.

Took up march at 6¼ o'clock. In 3.5 miles pass Warm Spring and a mail-station. Soon after starting it commenced to rain, which softened the road at the outset so much as to cause the wagons, 6 miles from Fish Springs, to stall occasionally in a distance of one-quarter of a mile. Detained an hour on this account. At this point the road doubles the point of the range along which we have been traveling, and continues on the plain of the desert toward the Go-shoot or Tots-arrh Mountains, meaning high mountain range. After making a journey of 29.7 miles, and coming for the first time to grass, the mules beginning to give out, we were obliged about sundown to encamp without water, except that in our kegs. I however found water 2.5 miles ahead, to which we will move to-morrow. The journey to-day has been a hard one, on account of the sandy and, in some places, boggy character of the soil. The country passed over is as desert a region as I ever beheld, scarcely a spear of grass visible, and in some areas not even the characteristics of an arid soil, greasewood, or sage. In some places the ground is perfectly bare of everything, and is as smooth and polished as a varnished floor. The first grass we have met with is that in which we are encamped.

The Go-shoot or Tots-arrh Mountains have been nearly all day long directly ahead of us, and appear very high. The peaks are covered with snow, and some 70 miles quartering to the left from our camp may be seen a towering one, which I call Union Peak, on account of its presenting itself in a doubled and connected form.* The geological character of the range is sedimentary, intermingled with quartz-rock

Our teams, considering the hard winter they have just passed through at Camp Floyd and the short forage upon which, of necessity, they have been fed, have thus far done remarkably well.

May 8, *Camp No.* 6, *Great Salt Lake Desert.*—Altitude above the sea, 4,593 feet. Bugle sounded reveille at 4. Morning bright and clear. Thermometer at 4½ a. m., 33°.75. Moved at half past five. In one mile, pass on our left an alkaline spring. Water not drinkable. In 1.2 miles more, come to a sulphur spring, where there is an abundance of water and grass, and where we encamped. It being Sunday, and the animals and party requiring rest, we have only made this short march of 2.5 miles to get to feed and water. The water, though sulphurous, is quite palatable to man and beast.

The shrill whistle of the curlew and the harsh croaking of the sand-hill crane indicate that we are in a better region than that we have been passing over for a few days back. The view from this camp, in contrast with that we have witnessed since we left General Johnston's Pass, is quite refreshing. Grass can be seen for a considerable stretch in the valley to the south of our camp, and the mountains, among them the Granite and Go-shoot Mountains, hemming us in at distant points, make up an agreeable landscape.

Just before dinner a Parvan (Ute) Indian (Black Hawk) came into camp. This is

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(*) This peak was again seen on our return route, July 20, and still, in its recesses, it was covered with snow.

the first Indian we have seen on our route. His squaw is a Go-shoot woman, and he lives among that people. Gave him his dinner and some tobacco. Had a sketch of him taken. He wears his hair tied up at the temples and behind; carries a buckskin pouch and powder-horn; a bow and quiver swung on his right side; wears a pink checked American shirt, buckskin leggins and moccasins, and a blanket around his loins; an old black silk handkerchief is tied about his neck. He has one huge iron spur on his right heel, and rides a sorrel pony. His height is 5 feet 7½ inches; has a stout square frame; age, probably, 35; carries a rifle. His bow is 3 feet long, and is made of sheep's horn; arrow, 25 inches long, feathered, and barbed with iron. His countenance is ordinarily sardonic, but lights up in conversation, and shows as much intelligence as Indians do ordinarily.

This evening, just at dark, two six-mule teams, belonging to the mail company, came in from Ruby Valley, and, after watering, continued on to Fish Springs. Took them five days to make the trip, they lying over one day. Report the road worked through to Ruby Valley, and the mail-stage is to run the next trip as far as the station in that valley from Camp Floyd. Heretofore it has run only as far as Simpson's Spring; from that point to the Humboldt River the mail has been carried on pack-mules.

May 9, *Camp No.* 7, *Sulphur Spring.*—Longitude, 113° 46′ 19″; latitude, 39° 40′ 36″. Altitude above the sea, 4,633 feet. The forage brought by the three teams from Camp Floyd being about expended, they left this morning on their return to the post. Morning bright and clear. Thermometer at 5 a. m., 37°.25. Resumed march at 25 minutes of 6, and shaped our course south of west for a wide pass through the Go-shoot Mountains, which we commence ascending in 4.5 miles. In 6 miles more you reach the east summit (altitude above the sea, 6,903 feet), by a tolerable grade, and thence, in 2.5 miles, descend, by a good grade, to Pleasant Valley, where we find an abundance of grass and plenty of water. A mile more brought us to the spring, the copious source of the stream which runs eastwardly through the valley into a large valley, which I call Crosman Valley, after Lieut. Col. George H. Crosman, deputy quartermaster-general and chief of the quartermaster's department in the Military Department of Utah. This stream (Pleasant Valley Creek) has a width of 12 feet, is 5 feet in depth, of sandy bottom, and has a rapid current. The water is of a very pure, wholesome character. Near the spring we encamp, after a march of 13.4 miles. At this point is a mail-station, a log house. The mail company has done a great deal of work in the pass we have just come through, in removing rocks, filling up gullies, and making side cuts.

We have to-day seen a number of Go-shoot Indians. They are most wretched-looking creatures, certainly the most wretched I have ever seen, and I have seen great numbers in various portions of our country. Both men and women wear a cape made of strips of rabbit-skins, twisted and dried, and then tied together with strings, and drawn around the neck by a cord. This cape extends to just below the hip, and is but a scant protection to the body. They seldom wear leggins or moccasins, and the women appear not to be conscious of any impropriety in exposing their persons down to the waist. Children at the breast are perfectly naked, and this at a time when overcoats were required by us. The men wear their hair cut square in front, just above the eyes, and it is allowed to extend in streamers at the temples. The women let their hair grow at random. They live on rats, lizards, snakes, insects, grass-seed, and roots, and their largest game is the rabbit, it being seldom that they kill an antelope.

I learn from Mr. Faust, the mail-agent at this point, that there are only about 200 Go-shoots all told of every age. They use, generally, the bow and arrow, there being only one gun to about 25 men. He represents them as of a thievish disposition, the mail company having lost by them about 12 head of cattle and as many mules. They steal them for food.

The farm the Government has opened for them is on Deep Creek, 25 miles west of north from this station. The Indian agent is Mr. Jarvis. Mr. Faust represents the valley of Deep Creek (by Beckwith called Fish Creek, by others I-van-pah), as quite large and fertile. The creek is narrow and so deep (from 6 to 12 feet) as to drown animals, and 1,500 acres of good land can be profitably irrigated by it. Captain Beckwith, in speaking of this valley, says: "The valley is here several miles wide, and the stream lined with grass, which is not all, however, of superior quality. Many of the small settlements of Utah are not so well supplied with the requisites for successful cultivation as those found on this stream." Mr. Faust also represents that there is a large quantity of fine timber (pine, fir, and cedar) in the vicinity, and, doubtless, building-stone.

Just at sunset I walked out with Mr. Faust to see some of these Go-shoots at home. We found, about 1.5 miles from camp, one of their habitations, which consisted only of some cedar branches disposed around in the periphery of a circle, about 10 feet in diameter, and in such a manner as to break off, to the height of about 4 feet, wind from the prevailing direction. In this inclosure were a number of men, women, and children. Rabbit-skins were the clothing generally, the poor infant at the breast having nothing on it. In the center was a camp-kettle suspended to a three-legged crotch or tripod. In it they were boiling the meat we had given them. An old woman superintended the cooking, and at the same time was engaged in dressing an antelope-skin. When the soup was done, the fingers of each of the inmates were stuck into the only dish, and sucked. While this was going on, an Indian came in from his day's hunt. His largest game was the rat, of which he had a number stuck around under the string of his waist. These were soon put by the old woman on the fire, and the hair scorched; this done, she rubbed off the crisped hair with a pine-knot, and then, thrusting her finger into the paunch of the animal, pulled out the entrails. From these, pressing out the offal, she threw the animal, entrails and all, into the pot.

The rats are caught by a dead-fall made of a heavy stone, and supported by a kind of figure 4, made as it ordinarily is for a trap, except that, instead of a piece of wood, a string is used, tied, and provided with a short button, which, being brought around the upright, is delicately held in position by a spear of dried grass or delicate piece of wood, which, pressing against the button, rests at the other end against the ground or stone. Traps like these are placed over the holes of the rats, and they, coming in contact with the long or lower piece of the figure 4, bring the stone upon them. They are also speared in their holes by a stick turned up slightly at the end and pointed, and with another, of a spade-form at the end, the earth is dug away until the animal is reached and possessed.

The Go-shoots, as well as the Diggers, constantly carry about with them these instruments of death, which, with the bow and arrow and net, constitute their chief means for the capture of game. Hanging on the brush about their "kant," as they call their habitations, I noticed one of these nets. It was well made, of excellent twine fabricated of a species of flax which grows in certain localities in this region, is 3 feet wide, and of a very considerable length. With this kind of net they catch the rabbit. A fence or barrier, made of the wild sage-bush plucked up by the roots, or cedar branches, is laid across the paths of the rabbits, and on this fence the net is hung vertically, and in its meshes the rabbit is caught.

The fear of capture causes these people to live generally some distance from the water, which they bring to their "kant" in a sort of jug made of willow tightly platted together and smeared with fir-gum. They also make their bowls and seed and root baskets in the same way—a species of manufacture quite common among all the Indian tribes, and which, in 1849, I saw in the greatest perfection among the Navajos and Pueblo Indians of New Mexico.*

I noticed a species of the food they eat, and which is made from seeds and roots which they get in the bottoms. I tasted it, but it looking precisely like a cake of cattle-ordure, and having anything but an agreeable taste, I soon disgorged it.

The Go-shoots, according to Mr. Bean, my guide of last fall, who has lived in this country for the last ten years, and professes to be well acquainted with the various tribes inhabiting the Territory, are an offshoot from the Ute Indians, and left their tribe about two generations ago, with their leader or chief, Goship, a disaffected leader. Their proper name, therefore, is probably Goship-Utes, which has become contracted into Go-shoots. Their language is a sort of gibberish, made up of the Ute and Sho-sho-nee dialects. It is said they are little esteemed by the original tribe, though I find occasionally a Ute Indian among them married to one of their people. They have until recently recognized no chief. Now, at the instigation of the Government, they have elected one, but as yet do not know how to respect him. It was amusing to see how the women slyly tucked under their rabbit-skins the hickory (checked) shirts we gave them, their whole demeanor representing that they are a suspicious, secretive set.

We found the guide, Mr. Reese, at our present camping-ground. He found the water at the places represented by the Indian he took with him from Camp No. 5, but farther south than he had gone. Paid the Indian in tobacco and a couple of hickory shirts.

May 10, *Camp No.* 8; *Pleasant Valley.*—Altitude above the sea, 6,150 feet. Ice formed in the bucket last night. Thermometer at 5 a. m., 33°.75. The guide, with Ute Indian Pete and two other men, left us this morning to continue an examination of the country to the south of and parallel to our route. They are to continue on, if possible, in that direction, and join us in Ruby Valley.

Pleasant Valley, which is very narrow, contains grass all along it, but no water above the spring where we encamped last night, except occasionally. The mountains are covered with cedars, and also contain pine and fir large enough for building purposes, and stone. Below the spring there is a very limited amount of cultivable land, which might be irrigated. This is the first cultivable land we have seen since we left Camp Floyd. The universal scene has been an arid, light argillo-arenaceous soil in the valleys, and the *artemisia* more or less everywhere. From Pleasant Valley to Camp No. 8, the road, which has a general direction north of west, traverses in 8.5 miles two or three steep but short hills, which, however, did not require the teams to be doubled, to the west summit of the Tots-arrh range (altitude above the sea, 7,150 feet), and thence 4 miles to camp. The mail company have done on this portion of the route some little work, but not enough to make the road what it should be. The road as made does not follow the direct pack-route, but makes quite a detour to the right or north. The mail-man, who has piloted us from the last camp, says a road, however, could be made by the pack-mule route, which would save several miles. The difficulty is a very steep declivity into Antelope Valley.

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* See my report of Navajo expedition, Sen. Ex. Doc. No. 64, 31st Cong., 1st sess., p. 118.

The formation of the Tots-arrh range, in which Pleasant Valley lies, is made up of slaty and calcareous rocks, mostly highly altered, and on the south side of the valley are seen granite rocks and quartzite. On the west side, near our present camp (No. 9), impure limestones and sandstones abound, pointing to the Carboniferous formation. The soil of the valleys correspond.

The Go-shoots that came to our camp in Pleasant Valley have followed us to our present camp, and have been regaling themselves with the entrails and refuse of a beef we have killed.

Two of our party went in advance to shoot antelope in Antelope Valley, in which we are informed they are frequently visible; they have returned, however, unsuccessful. Journey, to-day, 12.5 miles.

In this country, where grass is scattered as it is in the case of the bunch-grass, or scarce, it is necessary, in order to keep up the condition of the animals, to herd them. For this purpose we have four herders, three of whom are Mexicans and one an American. One of these drives the herd during the day, the others sleeping in the wagons, and at night the last mentioned take care of them. We have, therefore, brought with us only a few lariats for the horses, which, however, are seldom used except as guys to our wagons along side-hills, and to close up the gaps between the wagons when corralled for stock-catching in the morning. At Camp Floyd and other places in Utah, there are a number of Mexicans who prove valuable as herders. Besides being capital for looking up stray animals, they are generally expert in throwing the lasso.

May 11, *Camp No.* 9, *east slope of Antelope Valley.*—Altitude above the sea, 6,658 feet. Ice formed again last night. Thermometer, at 4½ o'clock this morning, 22°. Atmosphere sharp but clear. Moved at 25 minutes of 6. Course, south of west across Antelope and Shell Valleys. Just after leaving camp we have a fine distant view of the mountains hemming in the Antelope Valley at the west and north. After getting across the valley you can see to the east of south, glittering with snow, the high peak of the Go-shoot, or Tots-arrh range (Union Peak), some 60 miles off. This valley runs north and south, is flatly and smoothly concave, and about 12 miles wide; is bounded on the east by the Tots-arrh or Go-shoot range; on the west by the Un-go-we-ah, or Pine Timber range, which are next to the Tots-arrh in height; at the north distantly it appears to be hemmed in by mountains, and at the south is uninterrupted in view. Altitude above the sea, 5,690 feet. The soil is a sandy gravel on the benches, in the bottom argillaceous and covered with short sage. In the vicinity where we cross it there are no indications of water or grass, but some 50 miles to the south of us, to the north of our return-route, there is water and an abundance of grass. After crossing Antelope Valley, you ascend a rather low range of mountains, composed of slaty, stratified rocks, by a tolerable grade, and get into a shallow valley, called Shell Valley on account of its being covered with shale. Crossing this you descend over a formation of dioritic rocks, in 2 miles, by a good grade, into Spring Valley, where there is an extensive bottom of alkaline grass and of spring water, and where we encamp early in the afternoon. Journey, 19 miles; road generally good.

This is a narrow valley, running north and south, and lies between the Un-go-we-ah range on the west and a low minor range on the east. It is called Spring Valley, from the number of springs which make a chain of small shallow lakes or ponds in the direction of its length. The grass in it is abundant, but coarse and alkaline. Better grass can be found in the ravines and on the bench on the west side of the valley. The alkaline nature of the soil makes it unfit for cultivation. The formation of the valley, which is of a highly metamorphosed character, is composed, probably, of semi-fused stratified rocks.

Found some Root-Diggers here, one a very old woman, bent over with infirmities, very short in stature, and the most lean, wretched-looking object it has ever been my lot to see. Had her likeness taken.

These Indians appear worse in condition than the meanest of the animal creation. Their garment is only a rabbit-skin cape, like those already described, and the children go naked. It is refreshing, however, in all their degradation, to see the mother studiously careful of her little one, by causing it to nestle under her rabbit-skin mantle.

At first they were afraid to come near us, but bread having been given to the old woman, by signs and words she made the others in the distance understand that they had nothing to fear, and prompted them to accompany her to camp to get something to eat. Notwithstanding the old woman looked as if she was famished, it was very touching to see her deal out her bread, first to the little child at her side, and then, only after the others had come up and got their share, to take the small balance for herself. At camp, the feast we gave them made them fairly laugh for joy.

Near our camp I visited one of their dens or wick-e-ups. Like that already described, it was an inclosure, 3 feet high, of cedar-brush. The offal around, and in a few feet of it, was so offensive as to cause my stomach to retch, and cause a hasty retreat. Mr. Bean told me the truth when he spoke of the immense piles of *fæces* voided by these Indians, about their habitations, caused doubtless by the vegetable, innutritious character of the food.

These Digger Indians certainly demand the care and beneficence of the Government, and it is a satisfaction to know that an Indian agent has been sent among them to teach them the arts of civilized life. Sure I am, if the discontented among our people could only see these poor creatures in their want and wretchedness, they could not repine at their lot.

I noticed the women carrying on their backs monstrous willow baskets filled with a sort of carrot root, which they dig in the marsh, and the cacti, both of which they use for food. The stature of these Indians, both male and female, is under size. After dark a number came in; but it is a rule with us not to permit them to remain all night in camp, and they were told that though they could not remain with us, they could come in the morning. Their joyous conversation shows that they believe they have got among good friends.

May 12, *Camp No.* 10, *Spring Valley.*—Altitude above the sea 6,133 feet. Thermometer at 4½ o'clock this morning, 22°. Had quite a cold night; fires still desirable in the morning; water in the valley frozen over. Ever since we left Camp Floyd snow has covered the high mountains. The grass in the valley is yet but a few inches long. On the sides of the mountain, however, where it is to be found, it is sufficiently long for grazing. This valley, doubtless on account of its altitude, is a cold one.

In consequence of some of our mules straying away, which, however, were found, we did not get off till 20 minutes after 6. Our Go-shoot friends were in camp again just before starting, and were a little impudent, so much so as to cause me to give some significant evidences of displeasure. Our course lay west of north for about 3 miles, when we turned up a ravine south of west, along a rapid mountain-stream (Spring Creek), which we followed for 3.5 miles, when we left it, and continuing up a branch ravine, in 2 miles, by a good wagon-road grade, attained the summit of the Un-go-we-ah range (7,530 feet above the sea), whence could be seen lying immediately to the west of us Steptoe Valley. Descending the west slope of the mountain, which is somewhat steep, about 2 miles more, along a pure, mountain-gushing stream, which I call after Lieutenant Marmaduke, of the Seventh Infantry, brought us to the mail-station on the east side of Steptoe Valley, in the vicinity of which we encamped after a journey of 11.1 miles among good grass, water, and fuel.

The road crossed the stream, which I call Spring Creek, on the east slope of the range, several times. These crossings, which are short, boggy pitches, the mail company has not properly fixed, and the consequence was we were detained two hours by the breaking up of a tongue. This stream is 4 feet wide and 1 foot deep, and there is an abundance of grass in the ravine all along, from about 1.5 miles above its entrance into Spring Valley. It therefore furnishes a better camping place than Spring Valley. Gooseberry bushes grow along the creek, and cedars abound on the side-hill, and cedars, pines, and what the Mormons call *mountain mahogany* in the pass. This tree (the *Cercocarpus ledifolius*) grows generally at the summit of the passes. It is somewhat scrubby in appearance, ramifying in several branches from the ground, and in form resembles the apple-tree. Its greatest height is about 20 feet, and the aggregate breadth of its branches 20 feet. Its wood is very hard, and is used for cogs, journals, gudgeons, &c. A minute description of it by Dr. Engelmann will be found in Appendix M.

In this ravine we met a couple of men belonging to the mail-station where we are encamped, one of them named Lott Huntingdon, who says he has charge of the mail company's operations from Pleasant Valley to the Humboldt River. They were in search of mules, which they reported as having been run off by the Indians last night. They were sure of it because they had tracked them. Fortunately we had fallen in with the mules, and they had joined our herd. It was also in this ravine where I saw a deserted wick-e-up, in which Mr. Lee found a charred human skull—whether the result of cannibalism, sacrifice, or accident, we do not know.

The ravine in which we are encamped is also well grassed, and there are others of the same character in the vicinity.

The Un-go-we-ah Mountain-range, which we have just crossed, is composed of porphyritic rocks and altered stratified rocks (quartzite, slaty rocks, and siliceous limestones), heaved up to the summit.

Called at the mail-station. I find the mail company's road-party, consisting of eight men, have worked the road no farther than this camp. From this point onward we will have to open the road ourselves. They report a stream in the bottom of Steptoe Valley, six miles distant, which we will have to cross, and cannot do without bridging. Breadth 25 feet. They have been hauling logs to the spot for the purpose, and have nearly all that will be required. They promise to haul the remainder to-morrow, so as to enable us to build the bridge. The mail accommodations at this station are a shed and tent.

May 13, *Camp No.* 11, *east slope of Steptoe Valley.*—Altitude above the sea, 6,600 feet. Last evening it commenced blowing very hard, and this morning we have a cold, driving snow-storm from the east. Thermometer, at 5.45 a. m., 34°.25. Lieutenant Murry and myself left, with a small party of soldiers and teamsters, to make the bridge in Steptoe Valley, referred to yesterday, the balance remaining in camp. By noon the bridge was finished except a few logs, which the mail company promised to haul and put on. Lieutenant Murry deserves credit for his energy in this work. It snowed and rained at times during the day, till in the afternoon the clouds broke away, and the sun came out bright. The wind was high all day.

Mr. Huntingdon has been in this region during the past winter, and says there were six feet of snow in the upper portion of the cañon, in which the mail-station is, and two feet at the station. The mail party also inform us that Mr. Egan, the principal agent of Chorpenning & Company, tried twice to get south from Ruby Valley, toward Genoa, in Carson Valley, but was once defeated by the snow, and once business in Salt Lake City diverted him. It is from this point, near the southern extremity of Ruby Valley, Hasting's Pass, where we reach it, that I contemplate striking off southwestwardly from the route we are following, and shall attempt to get through with our wagons to Genoa in that direction.

The mail from Camp Floyd passed this afternoon, on mule-back, to California, and the carrier reported two stages at Pleasant Valley Station, just through from Salt Lake City.

May 14, *Camp No.* 11, *east slope of Steptoe Valley.*—Weather still cold. Thermometer, at 5 a. m., 28°.25. The animals have been in good grass at this camp, and have recuperated by the day's halt. Moved at 5.30 o'clock. Course westwardly, directly across Steptoe Valley to Egan Cañon. This valley, trending about north and south, is bound by the Un-go-we-ah Mountains on the east, and the Montim* Mountains on the west, and is open at either end as far as the eye can reach. Its breadth is about twelve miles, and, like all the wide valleys we have crossed, is flatly concave in cross-sections. At the benches the soil is gravelly. In the bottom it is areno-calcareo-argillaceous, and on the west side of the valley, in wet weather, must bog a great deal. Greasewood is the characteristic; ordinary height, 3 to 4 feet. (See minute description of this shrub by Dr. Engelmann, in Appendix M). Along the axis of the valley a stream runs northwardly, which, at the present time, is twenty-five to fifty feet wide; bottom miry; depth, in places, three feet; current moderate. It is said to dry up in the summer. Curlew, ducks, and other aquatic birds frequent it. There is a considerable margin of salt grass along it, which would be poisonous to animals, though the water does not taste alkaline. This is a poor, arid valley, perfectly useless for cultivation where we cross it; but farther south, where I crossed it on my return, as my report will show, there is a great deal of good, available pastural and cultivable soil. Altitude above the sea, 5,816 feet. Small streams, however, of pure water course down from the mountains and sink generally before reaching the middle of the valley; and on the mountain-sides and in the ravines is to be found a great deal of grass.

On account of the marshy approach to the bridge we constructed yesterday over this creek, we were detained three-quarters of an hour. Several of the wagons were taken over by hand. At noon, 6.8 miles from bridge, we reached the mouth of Egan Cañon, down which a fine, rapid stream runs, and on which we encamp. Grass on the side of the mountain. Journey 13.3 miles. Road good to the bridge; and from there, a part of the way, the soil is light and porous, and cuts up easily. After reaching camp-ground, I examined, with Lieutenant Murry, Egan Cañon, which had been reported as requiring considerable work to enable the wagons to pass, but find little will be necessary. We have had to-day with us, from Steptoe Valley, one of the mail company's men, who joined us at my request and by direction of Mr. Egan.

This afternoon the astronomical transit was set up for observations of the transit of the moon and moon-culminating stars. We were successful in the evening with our observations. Also observed as usual for time (or longitude) and latitude. Also took four sets of lunar observations for longitude with sextants and artificial horizons, two sets being on each side of the moon. Lieutenant Smith observed for double altitudes of the stars; Lieutenant Putnam, for double altitude of the moon; and I, for lunar distances, Mr. Lee noting audibly the time. The observations, being simultaneous, are regarded as quite satisfactory. I would ask, "Are you all ready?" If so, each would reply, "Ready!" I would then say, "Count!" While Mr. Lee was counting, Lieutenant Smith would be keeping up the superposition of the reflected and direct image of the star in the artificial horizon; Lieutenant Putnam, the tangential contact of the reflected and direct image of the bright limb of the moon, also in an artificial horizon; and I, the tangency of the star and bright limb of the moon directly. At the proper instant, I would call out the time, and if the other observers would respond, "All right!" to my query, the angles of time were recorded. We got through at midnight. Also, determined the magnetic variation at this camp, by observations on Polaris.

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* The meaning of this word I have not been able to ascertain.

The survey of the day is plotted after getting into camp, and thus, as we proceed, we have daily a correct view of our position. All of our notes, astronomical and barometerical and itinerary, are also perfected. The four chronometers are also daily, at the same hour, compared, and a record kept of the daily difference of each with the large box-chronometer. Find longitude of this camp (No. 12) to be 114° 58′ 15″; latitude, 39° 51′ 46″; altitude, 5,986 feet; magnetic variation, 16° 47′ E.

The dews in this region are scarcely perceptible, and my flannel, I notice, is generally highly charged with electricity.

May 15, *Camp No.* 12, *mouth of Egan Cañon.*—Extremely cold this morning. Thermometer at sunrise, 26°. Air pure, sun bright, and the wind strong from the west. Moved at quarter to 6. The pioneer party went ahead, in order to prepare the road. Our course is westward, up Egan Cañon, by an easy ascent, to Round Valley, about 2.5 miles, thence six miles across Round Valley, and by a ravine which required some work, to the summit of the Montim range (elevation above the sea, 7,135 feet), and thence 9.5 miles across Butte Valley, to the vicinity of a small well on the west side of the valley.

Egan Cañon we found quite narrow, and somewhat remarkable on account of the rocks which wall it in on either side. These rocks are tremendously massive, and rise sheer to a height in one place of about 1,000 feet. They are a compact quartz granite, of a grayish color, which becomes embrowned by exposure, and is intermingled with altered slate. Small veins of pure white quartz are seen traversing it very conspicuously. The general character of the range (Montim) is granitic at the base in some places, but mostly tilted and highly-altered stratified rocks, quartzite, slates, &c. Higher up, siliceous limestones, and, on the west side, porphyritic rocks. The ravines and heights abound with cedar, and thick *artemisia* characterizes the valleys. Just after crossing Round Valley we passed through a sort of cedar and sage-brush fence, which must have been about .75 of a mile long, and put up by the Indians. Its purpose, doubtless, was to catch rabbits by the suspension upon it of a net, in the mode explained before, and their attempting to run through it.

The Montim Range, between Steptoe and Butte Valley, is the boundary between the Go-shoot and Sho-sho-nee tribes of Indians; the latter ranging to the west of the line.

Round Valley, which is about 4 miles wide and 16 miles long, abounds in grass.

Butte Valley ranges north and south, and at the north appears to be uninterrupted except by low hills; at the south it is closed in by a cross-range some 30 miles off. It is about 8 miles wide, and takes its name from the buttes or table-hills in it. Soil of the usual yellowish color, and of a dry argillo-arenaceous character, good for nothing but to sustain the *artemisia.* (Altitude above the sea, 6,148 feet). The range of mountains limiting it on its west side are low, and, though covered with cedar, present but little indications of water. Those at the south end, from their height and snow, give better indications. The Humboldt range has appeared ahead of us to-day, looming up above the range limiting Butte Valley on the west, and is covered with snow. It is the most imposing range I have seen since leaving the Wahsatch Mountains, and is to be seen stretching far to the northward.

Our day's travel has been 18.1 miles, and, as it was quite warm in the afternoon, we found it very fatiguing crossing Butte Valley. Road generally good. Met five Sho-sho-nees on the road, clothed in rabbit-skins, like the Go-shoots, but all had leggings. We are encamped at the foot of a dark brown, isolated, porphyritic rock, near the summit of which is a small dug well, 10 feet deep and 2 feet wide. The water in this well can only get here on the principle of the siphon bringing it from some distant source. At present it is only 2½ feet deep in the well, and is barely sufficient for culinary purposes. The grass is about 1.5 miles to the northeast of the spring, on the side of the hill, and does not appear abundant. The dearth of water on the route to-day makes it important, if for no other reason, that the route should be changed farther to the south. (Subsequent to this date, in the summer, this point had to be abandoned by the mail company as a station on account of the well drying up. I have learned, however, that they have since found water in the vicinity, probably about 2 miles to the southeast, where a Sho-sho-nee told us there was water.)

The mail company has three traveling agents between Salt Lake City and the Humboldt River—Howard Egan, superintending agent; Ball Robert, district agent between Salt Lake City and Pleasant Valley; and Lott Huntingdon, the agent for the district between Pleasant Valley and the Humboldt. Then they have an agent called station agent, and from three to seven persons at each station, one being the mail-carrier. The number of mules varies at these stations from 8 to 15. The mail during this winter was carried on a pack-mule, which was sometimes led and sometimes driven. The required rate of travel (which was accomplished) was 60 miles in every twenty-four hours, changing every 20 to 30 miles. The superintending agent is said to get from $200 to $250 per month, the district agent $100, the station agent from $50 to $75, and the hands from $25 to $50, according to worth.

One of the mail company informs me that along the route from this station to the Humboldt they had last winter to subsist themselves on mule and coyote (wolf) meat. Their stock was transferred from the old road so late last fall as to have caused the death of one man, who died from cold on his last trip over the Goose Creek Mountains, and they were consequently ill supplied with provisions on the new route. During the winter the stock had a little grain, but subsisted principally on grass. The snow on the divide between Butte and Steptoe Valleys was from 2 to 4 feet deep; in some places in the mountains as much as 10 feet; in Butte Valley about 18 inches.

It is reported by some of the mail company that there is a cave, about three days' travel to the south of Steptoe Valley, into which persons have traveled a mile; some say as many as 3 miles, when they came to a precipice which prevented their going farther. They rolled rocks down, and the lapse of time before striking the bottom showed the depth to have been very great. There is said to be a number of rooms, in one of which is a beautiful spring. It was found by some persons who came from Fillmore City and traveled west. The location of the cave is not given, however, with any precision, and it is not in my power, for want of time, to certify, myself, to the truth of the report. (I may as well say here, however, that on our return route, which was 25 or 30 miles to the south of this, although we saw some small caves, we saw none of the extent described.)

May 16, *Camp No.* 13, *west slope of Butte Valley.*—Altitude 6,523 feet. First mild morning we have had. Thermometer at 5 a. m., 32°. Moved at 20 minutes of 6. Course continues a little north of west. In 2 miles reach summit of divide between Butte and Long Valleys (altitude above the sea 6,670 feet), by a very gradual ascent, and 2.5 miles more, by an easy descent, reach Long Valley. This valley, which lies, like those we have crossed, from south to north, is shut in by a pretty high mountain at its north end, from 10 to 15 miles off, showing passes in that quarter; and the south end appears closed, some 25 or 30 miles off, by a cross-range, also exhibiting passes through it. Elevation above the sea, 6,195 feet. Crossing this dry valley, which is 2.7 miles wide, 3.1 miles more up a tolerable grade brings you to the summit of a low range, running north and south, dividing Long from Ruby Valley, about one mile below which, on the west slope, we encamp, at a spring just discovered by Lott Huntingdon, of the mail party, and which therefore I have called after him. It is a good camping-place, and grass and fuel are convenient. Journey to-day, 12 miles. Road good.

Siliceous limestones were seen in the range dividing Butte and Long Valleys; and in the range bordering this last valley, on its east and west sides, are light-yellowish, earthy limestones, full of fossils of the Carboniferous range; also compact light-gray limestone, some siliceous and slaty rocks, &c. Igneous rocks, of a basaltic appearance (brown porphyry), are found near the limestones in the vicinity of Huntingdon Spring. Soil of valleys accordingly.

Cedar and pine characterize the *Sylva* of the mountains, and the *Artemisia tridentata*, or wild sage, a certain index of sterility, the valleys. The latter has impeded our wagons a great deal to-day, and has been seen almost everywhere from Fort Laramie as far as we have come, and was afterward found to characterize the country even to the east foot of the Sierra Nevada.

A high snow-mountain has appeared some 30 miles off to the south of us, which will doubtless be of service in furnishing water on our return trip in that quarter. Several antelope have been seen for the first time since we left Camp Floyd.

About an hour after we went into camp the guide and party came in. It will be recollected that he parted from us at Pleasant Valley, Camp No. 8, May 10. He reports that in consequence of his getting out of provisions, and the Indian he had picked up as guide knowing nothing of the country farther west, he struck north for our trail, and met it at the bridge in Steptoe Valley. Thence he followed our track. He represents that he has found a route generally parallel to the one we are on, and some 30 miles to the south, which is practicable for wagons, and furnishes water and grass at intervals of 15 to 20 miles. Indeed, a good portion of the way is an old wagon-road, which, according to Lott Huntingdon, was used by a party of emigrants who attempted to make their way from Fillmore to California and perished. (On our return trip, however, we got on this road, and were told by the Indians that it had been made by the Mormons the spring previous, and was, without question, that which they made when they fled before the approach of the troops, and when it was reported they had gone to Silver Mountains.)

Got a number of the Sho-sho-nee words through Ute Pete from a Sho-sho-nee, by name Tar-a-ke-gan. It is to be regretted that the necessity of sending Pete always with the guide, so as to enable him to get information from the Indians in relation to the country south of us, makes it impossible for me to have that converse with the Indians I meet which I would like in order to obtain a knowledge of their manners, customs, &c. But to get a good wagon-road, if possible, to the south of us, is of the first importance, and therefore the guide cannot dispense with his services. Besides, though young, he is a capital *voyageur*, and well acquainted with signs of water, grass, &c.; and already in this respect the chief guide has found him invaluable. I can never forget the kindness of Dr. Hurt in recommending him to me.

May 17, Camp No. 14, Huntingdon's Spring, east slope of Ruby Valley.—Altitude above the sea, 7,190 feet. The guide leaves us again this morning with a Sho-sho-nee Indian, Tar-a-ke-gan, to go south, and continue his examination of the country south and west, and will join us at our first camp after leaving Ruby Valley. Pete and two others of the party accompany him.

Thermometer at 5 a. m., 44°. Move at quarter to 6, and, shortly after attaining summit of Too-muntz range (7,283 feet above the sea,) pass down a cañon, which I call Murry's Cañon, after Lieut. Alexander Murry, the commanding officer of the escort. The rocks are more calcareous and slaty than those we passed yesterday, and are of yellowish color. Some little work done in the cañon, to allow the wagons to get along. In 3.9 miles we reach the mouth of the cañon, and immediately cross Ruby Valley, requiring 5.3 miles more of travel to mail-station in the valley, where we encamp at 9.30 a. m. Journey, 9.2 miles. Road good.

At our camp is a spring which sends out a small stream of pure water, flowing along the valley northwardly. Ruby Valley is well supplied farther north with streams from the Humboldt Mountains, which limit it on its west side; and some 25 or 30 miles north of us, in the valley, is said to be a large lake, which doubtless is Beckwith's Lake Franklin.

This valley, like all those we have crossed, has a dirty-yellowish, forbidding appearance; is covered with *artemisia*, and very level, and has a thirsty appearance, though doubtless farther north it is more inviting. It is said to extend north as far as the Humboldt River, a distance of 60 to 70 miles, and has a great deal of cultivable soil in that direction, which is capable of irrigation. At the south, about 10 miles from our camp, it is hemmed in by the mountains, which close in from the east and west sides, showing, however, a pass through to the valley lying to the south. The breadth of the valley where we cross it is about 9 miles.

Mr. Jarvis, the Indian agent, has commenced, I am informed, an Indian farm in this valley, about 40 miles to the north of our camp, for the Sho-sho-nees. An abundance of grass, water, cedar, and pine is found in the mountains on either side of the valley, particularly in the Humboldt range skirting it on the west, and it is represented as being quite a warm valley. The snow last winter is represented as not having been more than one-half foot deep in it. In Hasting's Pass, which leads through the Humboldt range into the valley of the south fork of the Humboldt, the snow was 4 feet deep.

Large numbers of Sho-sho-nees winter in Ruby Valley, on account of its being warmer than the other valleys around. One of the mail party represents that as many as 1,500 must have staid here last winter. At the present time they are scattered, for purposes of hunting. They are a fine-looking tribe of Indians, and all those I have seen have good countenances. They have generally nothing but the brush-barrier or inclosed fence, summer and winter, like the Go-shoots, to protect them from the weather, though some of them erect pole-lodges. Mr. Huntingdon thinks that one-third of them carry guns; the rest carry the bow and quiver. They have committed no depredations lately, though last year they attempted to steal some horses from some emigrants.

A great deal of game, such as antelope and aquatic fowl, is said to abound in this region, and deer and mountain-sheep are also seen. Ruby Valley takes its name from the circumstance, so I am informed, of rubies having been picked up in it on the west side, a few miles north of the mail-station. However this may be, it is very certain we could not find any, and the probabilities are that it is no more a ruby valley than the others we have crossed. The mail-station at this point is at present a mere shed. Pine-log houses are at present being put up.

The Humboldt Mountains, white with snow, have for the last two days been seen at times, and have looked grand and massive. Their Indian name is Tac-a-roy, meaning snow-mountains. They are certainly the most formidable mountains we have seen since we left Camp Floyd, and are composed of siliceous limestones, quartzite, coarse sandstones, &c.

May 18, *Camp No.* 15, *Ruby Valley.*—Altitude, 5,953 feet. The mules ran against the cords of the barometer-tent early this morning and prostrated it, carrying with it the two barometer, swhich were suspended from the tripod. Fortunately, only one was affected by the accident, a little air getting into the tube, which can be easily remedied.

Thermometer at 4.45 a. m., 38°. Moved at 5½ o'clock. Struck immediately for Hasting's Pass, lying southwest from mail-station, the foot of which we reach in 2.5 miles, and the summit by a remarkably easy ascent in 3.3 miles more. This pass leads through the Humboldt range from Ruby Valley into the valley of the South Fork of the Humboldt, which some call Huntingdon's Creek. For the first time we in this pass get into Beckwith's, here coincident with Hasting's, road, both of which at the present time are very indistinct. Descending from the summit, by the finest kind of grade, in about 4 miles we leave Beckwith's and Hasting's roads, which go, the former northwestwardly to join the old road along the Humboldt, 10 miles above Lassen's Meadows, the latter northwardly to join the same road at the mouth of the South Fork of the Humboldt; while we strike southwestwardly, over an unknown country, toward the most northern bend of Walker's River, my object being to cut off the great detour which the other roads make in going all around by the Humboldt River and sink, to reach Genoa in Carson Valley. We also now leave Chorpenning's or Mail Company's extension of my route from Hasting's Pass, it also turning northward, and joining the old road near Gravelly Ford, which they follow by way of the sink of the Humboldt and Ragtown, on Carson River, to Genoa. Frémont, I notice by the Topographical

Bureau map, has traveled over a portion of the country to the southwest of us, but as he has never submitted a detailed report of this reconnaissance, and his track is no longer visible, and it goes too far south for our purposes, his exploration is of no service to us in our progress. From this point, therefore, to where we expect to strike the old road on Carson River, we will have to be guided entirely by the country as it unfolds itself. This Hasting's Pass, the summit of which is 6,580 feet above the sea, is the finest, on account of its breadth and easy grade, of any we have threaded, except Camp Floyd Pass. The twittering of the birds we found here also more resonant and delightful than in any other locality. There is a bird in the mountains a little larger than the jay, and of a deeper blue color, that utters an impudent screaming note, and seems to become particularly saucy in proportion as we approach it. It is, however, quite wild, and it is difficult to approach near enough to shoot it.

It was in this pass that Messrs. Duncan and Lufkin overtook us on their way from Salt Lake City to Genoa. They had left the city two weeks previously, and Mr. Duncan, who has traveled the old route by the City of Rocks, says he thinks the one he is now on is the best. They follow from this point the mail-route, toward the main Humboldt. I was much pleased with the little two-horse wagon they had with them. It was very light, and was hung at the middle on two springs, placed longitudinally; and they say they have carried 1,000 pounds in it over the Sierra Nevada. I should think it a capital wagon for rapid traveling over the plains. It was built at Concord, N. H.

After reaching the west foot of Hasting's Pass, in the valley of the South Fork of the Humboldt, we struck for a pass in the next western range, which we could see lying to the southwest of us, about 9 miles off, and which looked favorable for admission into the next valley. In 4 miles we struck the South Fork of the Humboldt, a rapid stream, stony bottom, 6 feet wide, ½ foot deep, course northwardly. We follow up this creek for about a mile, and then leaving it, in about 2 miles, come to a small mountain-stream flowing over a stony bottom, where we encamp at 1 o'clock. Grass along the stream, and plenty higher up on the slopes of the mountains. Sage plentiful. Journey 17.6 miles. Road good, though the high sage-brush, as usual, impeded us a little. This our heavy train, however, breaks down, and makes a very passable road for those who may follow us.

The valley of the South Fork of the Humboldt, which takes its rise near and to the northwest of our camp, is a very open one, both north and south; a slight rise some 15 miles off toward its south end, showing a rim in that direction. Its soil is a yellowish areno-argillaceous earth, which is capable, to a limited extent, of being irrigated by the stream running through it. As usual the *artemisia* covers the valley, and in this locality is quite rank in growth. Altitude of valley above the sea 5,640 feet.

A Sho-sho-nee Indian and his squaw, with her child strapped on her back, followed us to camp. Both seem kind-hearted and have good countenances. The child is a perfect picture of a fat, well-conditioned boy, and has a very pleasing expression of countenance. He is perfectly naked, and around his neck has several strings of wampum. The squaw is naked from her head to her loins, and is not in the slightest disconcerted by the gaze of spectators.

Mr. Reese, the guide, came into camp this evening, and reports plenty of water and grass, and a good country for a road parallel to our route, and south of us from the point he visited south of Camp 14 to the valley we are now in, but sees no way of getting through the range of mountains lying west of us, except by the pass near us, which we are aiming at. If so, the contemplated southern parallel route would be at this point too far north, and we should not gain in distance over the route we have come. I trust, however, we will yet find that we can continue our more southern route westwardly without deviating so much from the proper direction. I think I can see indications of a pass which will make the thing practicable. This proved to be the fact on our return.

We have had thunder and some little lightning this afternoon and evening, but only a few drops of rain.

May 19, *Camp No.* 16, *Valley of South Fork of the Humboldt.*—Altitude above the sea, 6,028 feet. Thermometer at 4.30 a. m., 38°.25. Morning bright and pleasant. Raised camp at 25 minutes of 6, and directed our course west of south to pass of the mountain-range directly west of us. In 2 miles cross a small rapid mountain-rill. These streams may not run in the summer and fall, but their sources, which are springs at the base of the mountains, are doubtless perennial. Wild parsnips, said to be poisonous to man and beast, abound here. Grease, or whisky and gunpowder, are said to be the antidote. Pass places where the Indians have dammed up the rills to cause them to flood the habitations or holes of badgers, gophers, rats, &c., and thus they secure them for their flesh and skins.

In two more miles we commence ascending the pass, which on the east side is quite steep, all the teams doubling but the leading one, and ropes being used to keep the wagons from upsetting. Some side-hill cutting done; train detained 2½ hours on that account. A road, however, of good grade can be made up the pass; (and since we traveled over it I have been informed that the mail company, which has transposed its stock on my route from Ruby Valley, has made a road here.) Probably south side of pass will furnish best grade. Altitude of summit of pass above the sea, 7,300 feet.

From this summit we obtain a most extensive view of distant mountains. Toward the east may be seen four distinct ranges, some of them covered with snow. These are the ranges we have been crossing for several days back. Toward the west, bounding a valley running north and south, and over which lies our course, may be seen a range, and back of it one or two more; the highest covered with snow. The valley referred to is quite white toward the north with a saline efflorescence, and bearing about due west and lying in it is a small lake, into which apparently runs a good-sized stream.

I visited a high promontory near the pass to reconnoiter for a pass through the next range lying immediately to our west. Determined to try the one bearing magnetically S. 40° W. as being the most favorable in direction. There is another bearing directly west, but it would be too far to the north. Directed guide to proceed to the pass in advance, and send back, first, a report about grass and water, at east foot of the pass for to-morrow's camp; and, subsequently, another in respect to the practicability of the pass. My plan has been to keep the guide well in advance, and to have him send or bring back reports from time to time, so as to have as little detention as possible, and get the best route.

Descending from pass by an easy grade down the west slope of the range, albeit in places slightly sidling, in 3 miles and at quarter to 1 p. m., encamped in splendid and abundant grass, near the small stream which comes down the pass. Day's travel 7.1 miles; road good except at points as stated, and which can be remedied.

Several Sho-sho-nees joined us on our route. One of them amused the party very much by his awkward attempts to mount a mule, and, when he got on, his rabbit-skin dress frightened the animal so much as to cause him to run off with his nondescript load, much to the merriment of the men. They wear their skin capes summer and winter, and on such a hot day as this I should suppose the warmth of it would be insupportable. I notice that before they venture to join us they take a good look at us from distant prominent points.

The merry sound of the blacksmith's anvil and forge, and the hammer of the wheelwright, after we got into camp, reminds me constantly of the very efficient manner, thanks to General Johnston, commanding the Department of Utah, in which I have been fitted out by the Quartermaster's Department. The army wagons are, however, of such superior character as very seldom to require repairs. On the march of the Utah forces from Fort Leavenworth these wagons were the admiration of every one, so strongly were they made, and so suitable in weight and capacity. I doubt if any army in any country can show anything superior. The portable forge, however, of which no expedition like ours should be destitute, we found indispensable for the preparation of the shoes for the animals, and other purposes.

Among the Sho-sho-nees who have visited our camp is Cho-kup, the chief of the Humboldt River band of the Sho-sho-nees. It is to be regretted, as I have before remarked, that I am obliged to let Indian Pete, the interpreter, go with my guide ahead, in order to talk with the Indians they may meet. I am thus deprived of the advantages of the information I might otherwise obtain from this chief respecting his tribe. I have had a sketch of him taken. He is a very respectful, intelligent, well-behaved Indian, and seems to have gained the approbation of the California Mail Company. In age I should suppose he was about thirty-five years. He is dressed in buckskin pants, a check under, and a woolen over shirt; has a handkerchief tied around his neck, wears shoes, and has a yellowish felt hat. His air is that of a man who, while knowing his own powers, is capable of scanning those of others. He showed me a letter of Mr. Chorpenning, recommending him as a good Indian, &c. This, together with my intercourse with him, has induced me, from motives of policy as well as justice, to give him the following paper:

"CAMP NO. 17, CHO-KUP'S PASS,
"*May* 19, 1859.

"To all whom it may concern:

"This is to inform persons that the bearer of this paper is Cho-kup, chief of the Sho-sho-nees south of the Humboldt River, and as he is represented, and from my intercourse with him, I believe him, to be a friend of the white man, and a good, respectable, and well-behaved Indian, I bespeak for him and his people the kind treatment at the hands of the travelers through their country that their recent good conduct entitle them to, and which, if they continue to receive, will insure all who may pass through their country safety to their persons and property.

"J. H. SIMPSON,
"*Captain Topographical Engineers.*"

I have made it a point to treat the Indians I meet kindly, making them small presents, which I trust will not be without their use in securing their friendly feeling and conduct. A great many of the difficulties our country has had with the Indians, according to my observation and experience, have grown out of the bad treatment they have received at the hands of insolent and cowardly men, who, not gifted with the bravery which is perfectly consistent with a kind and generous heart, have, when they thought they could do it with impunity, maltreated them; the consequence resulting that the very next body of whites they have met have not unfrequently been made to suffer the penalties which in this way they are almost always sure to inflict indiscriminately on parties, whether they deserve it or not.

The mountain range which we have just crossed, and near the foot of which we are encamped, is called the We-a-bah Mountains, or the mountains, as Ute Pete says, of the fluttering or night bird. It is composed of sandstones, siliceous conglomerates, and, distant from the road, of bluish-gray limestone. The general name for mountain, among the Sho-sho-nees, seems to be Toy-ap. The pass we have come through I call after the chief, Cho-kup's Pass.

May 20, *Camp No.* 17, *west slope of Cho-kup's Pass.*—Altitude above the sea, 6,018 feet. The dragoon I sent out with the guide returned last night at 10 o'clock, and reports water and grass 15 miles off, in the direction of pass, through the next range, ahead. Thermometer at 4.30 a. m., 38°.75. Moved at 5.30 o'clock. In 1 mile reach foot of pass in Pah-hun-nupe, or Water Valley. This valley apparently closed at south end, say 25 miles off; at north end, some 30 miles off; low passes apparently at either end. The indications are that this valley can be passed through over to a more southern, southeastern, or southwestern valley by practicable passes, a fact of significance on our return route. Sand-hill cranes, curlew, and other marsh birds abound in the valley, and antelope are seen in the distance. Six and eight-tenths miles farther brings us to a large spring, in marsh, where we water. Plenty of grass about it, though not of best quality. This valley is in some portions argillaceous and in some arenaceous. The latter glitter with small crystals of quartz, of very pure character, which we amuse ourselves in picking up, and facetiously call California diamonds. The appellation, doubtless, as veritable as the epithet of ruby, which seems to belong to the precious stones said to have been found in Ruby Valley. A great deal of alkaline marsh, and water in small lakes, north of route. Altitude of valley above the sea, 5,660 feet.

In 5.6 miles more reach a large spring on west side of valley, at foot of mountain range, where we encamp in pure salt grass, which the animals eat with avidity. It is, however, not abundant. Bunch-grass can be found in cañon back of camp.

Road to-day good, though it might cut up early in the spring. Higher ground, however, exists below or south of the road, over which, in this case, the wagons could travel. Day's travel, 13.3 miles.

The damaged barometer cleaned and refitted with fresh mercury by Mr. Engelmann. At sunset ascended high peak, back or west of camp, to view the pass we have been aiming at. It looks favorable. From this peak had a most magnificent view of the mountains in every quarter of the horizon—the Humboldt range, to the east of north, showing its white snowy summits far above the intervening ones. These distant views have, at least on my mind, a decidedly moral and religious effect; and I cannot but believe that they are not less productive of emotions of value in this respect than they are of use in accustoming the mind to large conceptions, and thus giving it power and capacity. The mysterious property of nature to develop the whole man, including the mind, soul, and body, is a subject which I think has not received the attention from philosophers which its importance demands; and though Professor Arnold Guyot, of Princeton, has written a most capital work on the theme, "Earth and Man", yet a great deal remains to be done to bring the matter to the profit of the world at large, which, it seems to me, a wise and beneficent Creator has ordained should be gathered from the contemplation and proper use of his works.

But then the question arises, Do we rise from the contemplation of nature to nature's God, and therefore to a realization of the amplitude and reach to which our minds are capable, by our own unaided spirit; or is it by the superinduced Spirit of the Almighty Himself, which we have received, it may be, on account of His only Son? But these speculations may be considered as foreign to the necessary rigor of an official report; and I, therefore, will indulge in them no further than to say that, according to my notions, the latter I believe to be the true theory.*

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* I must confess that in all the works of Baron Humboldt with which I am conversant, I have never seen anything to indicate that he ever arose in his conceptions of nature to the ultimate idea which, to my mind, they are intended to disclose, to wit, the power and goodness of the Creator, and thus to produce within us the ability and delight of adoring Him "of whom, and through whom, and to whom are all things," (Romans xi, 36.) In his *Cosmos* the utmost he says upon the subject is contained in this sentence: "The earnest and solemn thoughts awakened by a communion with nature intuitively arise from a presentiment of the order and harmony pervading the whole universe, and from the contrast we draw between the narrow limits of our own existence and the image of infinity revealed on every side, whether we look upward to the starry vault of heaven, scan the far-stretching plain before us, or seek to trace the dim horizon across the vast expanse of ocean." Now, here, the height of his conception is an idea of infinity, in connection with the order and harmony of the universe, but he sees or acknowledges nothing of an *Infinite Mind,* which has created and still upholds all things, and seems to be utterly unconscious of that *moral* and *spiritual microcosm,* which to some persons is mirrored in their souls when they contemplate nature in her grandest and most beautiful forms. Indeed, to my mind, his application of the word *Cosmos* to "*the universal all,*" (Το Παν,) and yet non-recognition of Him "in whom we live and move and have our being," and "by whom the world and all things therein were made," is as sensible as it would be for a physician to talk of the faculties and functions of the human body, and yet ignore entirely the sentient, reasoning soul, the seat of its life and the controller of its actions.

January 29, 1861.—Since writing the foregoing, I have read Professor Guyot's interesting address of February 16, 1860, to the American Geographical and Statistical Society, on Carl Ritter, the world-renowned author, as he terms him, of the classical "Erdkunde, &c., or the science of the globe in its relations to nature and to the history of mankind.' From this address I learn that the crowning excellence of this great physicist was his Christian belief and character, through which he was enabled to see nature purely and describe her graciously as the work of an all-wise and benevolent Creator, who has so harmonized all things, both in the world of matter and spirit, as by their beautiful adaptation, and relation to disclose the infinitude of Him who is the beginning and end, the alpha and omega, of all things.

The spirit in which Ritter studied nature is well shown by the motto which he placed at the bottom of the portrait presented to him by the students of the University of Berlin, through a committee, of which Mr. Guyot was one, On descending to camp, found Pete had come in from the guide's party, and he reports all right ahead for 18 miles, to a point where there is grass and water, and where I expect to camp to-morrow. It seems the guide took a pass a little to the north of the one I saw from the high promontory of Cho-kup's Pass yesterday; but Pete, in returning to camp, went through the one I referred to, and found it not only more direct but easier. Our observations place this camp (No. 18) in longitude 115° 56′ 52″, latitude 39° 49′ 43″.

May 21, *Camp No.* 18, *west side of Pah-hun-nupe Valley.*—Elevation above the sea, 5,692 feet. Morning bright. Thermometer at 4½ o'clock a. m., 32°. Raised camp at 5.25 a. m. Keep up the Pah-hun-nupe Valley, or south, two miles; then turn to the right up toward the pass of west range bounding the valley; two miles more commence ascending pass. Notice a couple of bush-fences or barriers converging to a narrow pass, and a large hole in this last portion. Pete says they are to guide deer near the hole, in which the Indian hides himself, and shoots them as they pass with bow and arrows at night, a fire being used as a lure. Notice a plant of small leaf, and taste of the turnip. In five miles more, by a very gradual ascent, reach second highest

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as follows: "Our earth is a star among the stars; and should not we, who are on it, prepare ourselves by it for the contemplation of the universe and its Author?"

Professor Guyot, in speaking of the special peculiarities of Ritter and Humboldt, in his address, discourses as follows:

"The picture that I have just attempted of Ritter's ideas, method, and labors sufficiently defines, if I err not, the part performed in geographical science by that faithful and gifted scholar, from that achieved by Humboldt. Humboldt seeks to determine the general laws of the physical world. Ritter seizes them as applied, and in their concrete and actual connection in every given country and in the whole globe, and considers nature in its totality as an element in the development of mankind, from which alone these natural forms and influences receive their true and final significance.

"At the moment these faithful guides leave us to ourselves, when their voice will utter no more words of wisdom, it may be well for us to ask ourselves how far they led us in the high-road of science, and what is the task which is still before us. Humboldt, with a surpassing richness of knowledge, attempted to give us a connected picture of the totality of the physical universe; but admirable as is the Cosmos, after having read its eloquent pages, we pause and involuntarily ask for the final object of the Creator in building up that marvelous structure; we ask for a tie which connects it with Him, at least that portion of the creation in which we dwell; for a voice which rises from it as a word of praise and we find it not. Far from me even the idea of casting a blame upon the great and good philosopher. I am fully aware that his plan was purposely limited to the material world which is his theme. I only wish to remark that we cannot stop there.

"It is, indeed, a universal law of all that exists, as I have elsewhere said, not to have in itself either the reason or the entire aim of its existence. Every order of facts, like every individual being, forms but a portion of a greater organization, the plan and idea of which go infinitely beyond it, and in which it is destined to play a part. The reason of its existence, therefore, is not in itself, but out of it; not below, but above it. The explanation of the beautiful but often mysterious arrangements of the physical globe is to be found not in it, but in the higher moral and intellectual sphere of man, for whom they were made, in order to be there the means of accomplishing a more exalted end than their mere material existence. The key which opens for us the mysteries of the evolutions of history, is to be sought in that future perfect economy which is its end, and toward which, under God's guidance, human progress is advancing with a steady step. A science of the globe which excludes the spirit world represented by man, is a beautiful body without a soul. Ritter, as I trust I have abundantly shown, put a soul into that body. This will make his memory live forever in the grateful remembrance of all lovers of true science.

"Let us, therefore, continue in the footsteps of these masters in science. Humboldt furnished the means, Ritter marks the goal. Like Humboldt, let us study nature in a truth-loving and devoted spirit, and with combined forces perfect that edifice which he has already reared so high. Like Ritter, let us, with scrupulous care and a pure mind, pursue in all parts of our earthly domain the investigation of these wondrous harmonies of nature and history of which he has traced the great outlines. With the lofty ideal which was before his mind, let us try to realize his conception, which still needs a further growth to unfold all its beauty; and we shall have a right to look with hope toward a future science and a future cosmos, which will be the full and adequate expression of the wisdom and goodness displayed in God's plan of the material and moral creation, which will satisfy all the legitimate craving of the human mind for knowledge, and which, by its very utterance, shall be, according to Ritter's own words, man's song of praise and of adoration to the divine Author of the universe."

summit of pass, whence can be seen, to the south and southwest, a low ridge trending apparently northwest and southeast, and, still farther, two other ranges, generally parallel to the other, and their highest portions covered with snow. Bearing, magnetically, south 5° west, probably some 25 or 30 miles off, is quite a conspicuous peak of one of the more distant ranges. Ever since we left Camp Floyd we have only crossed valleys and mountain-ranges, generally running north and south, to see others lying to the west of us, running in the same direction, and which we have in turn crossed. This system continues to prevail.

The pass we have come through, a most excellent one for a wagon-road, the only steep portion being for about 100 yards at the summit. Altitude above the sea, 6,757 feet. Cedar abounds in it and on the adjacent side-hills. Immediately to our north is a conical peak, which, as we found afterward, in our journey westward, continued for days a most notable landmark, and which I call Cooper's Peak, after Adjutant-General Cooper of the Army.

In 6 miles from summit, by an easy grade, at a quarter to 1 o'clock, reach the She-o-wi-te, or Willow Creek, where we encamp. The short, steep hill which we passed down just before reaching camp, may be turned at the south by making a short detour. She-o-wi-te Creek, a fine one, 4 feet wide, 1 foot deep, and quite rapid. It sinks about 1 mile below camp. Grass along it and on side-hills. Journey, 14.9 miles. Road good, except short hill referred to, which can be avoided. Passing generally over ridges and benches, the soil has been, in some places, arenaceous, in other, argillo-arenaceous, and, in most, gravelly. The rocks have been granular, crystalline, magnesian limestone of a light-gray color, near Camp No. 18, and, as we advanced, subcrystalline compact limestones, altered slates, quartzite, and other highly metamorphosed rocks have prevailed, indicating the proximity of igneous rocks.

The valley in which we are encamped differs from any we have seen. Heretofore they have ranged north and south, and averaged a breadth of probably only one-fourth their length. This one, however, has no particular form, and, while branching out laterally in different directions, shows a form as long as it is broad. The Digger Indians that have come into our camp call it Ko-bah, or Face Valley, a very good name.

There are three of these Indians, who appear to be grandfather, son, and grandson. They confirm the names of valleys and mountains as given by Cho-kup. I inquired of them the number of their kind of people. To this I could only get the answer there were very few of them. One of them is an old man of at least sixty years, and he as well as the others represent that they have always lived in this valley, and, never having gone far from it, cannot tell us of the water and mountains beyond their limited range. They say they have no chief, though they speak the Sho-sho-nee language; are clothed with the rabbit-skin cape, similar to the Go-shoots, and represent that they wear no leggings, even in the winter. This is scarcely credible, cold as the winter must be in this region, but it seems to be a fact. They are very talkative and lively. Eat rats, lizards, grass-seeds, &c., like the Go-shoots. The guide says he saw them, after throwing the rats in the fire, and thus roasting them, eat them, entrails and all, the children in particular being very fond of the juices, which they would lick in with their tongues and push into their mouths with their fingers. The old man represents that a number of his people died last winter from starvation and cold.

We found one of the guide's party here. The guide and another man are still out toward the southwest looking for a pass in that direction.

Five of the men within the last two or three days have reported themselves sick. The disease the doctor pronounces a species of intermittent fever.

This afternoon, just before sundown, Lieutenant Murry and myself took a stroll up the creek to view a wick-e-up of the Diggers that have visited our camp. It had been reported to be but about from one-eighth to one-fourth of a mile above our camp; but, with all the search we could give for about a mile up, we could see nothing of it. Returning on the other side of the creek, we at last got sight of it, it being only distinguished from the sage-bushes around it by the circular form given to its development, it being made of these bushes in their still growing state, and some few loose ones thrown in. To our surprise the inmates were gone. This we conceived strange, as they had come into our camp immediately on our arrival, and seemed to be very confident of protection and safety. What makes the matter more strange, it appears that in going off they shot an arrow into one of our beeves, which looks as if they had become offended at something. The wound, however, was but slight, and has done the animal no material damage.

May 22, *Camp No.* 19, *She-o-wi-te, or Willow Creek.*—Altitude above the sea, 6,414 feet. Thermometer at 7 a. m., 59°. Morning beautiful. Whole command allowed to sleep longer than usual, on account of our laying over to recruit our animals and observe the Sabbath. The guide came in last night about 11 o'clock, having traveled from daylight to that hour. He thinks he must have traveled 60 miles. Reports water to the west of south and also to the southwest of us, and our ability to get through the mountains in that direction. Assistant Surgeon Baily reports three more men on the sick-list with same complaint as already stated. This makes eight of the command unfit for duty. This day's rest, it is hoped, may be of service to them.

Learned this morning the cause of the conduct of the Indians yesterday, in leaving so hastily their wick-e-up, and shooting an arrow into one of our beeves. It seems the cook of my mess, as he says, jokingly pointed very significantly to the revolver about his waist, as a means to keep the dirty fellows from hovering, with their uncombed *lively* hair, over his viands; and the effect was just as he might have expected, an immediate scampering of them and their families from the vicinity, with some considerable hate in their bosoms, which was evinced in their flight by their putting an arrow into one of our beeves. I regret this act of thoughtlessness on the part of the cook exceedingly, both on account of its giving us a bad name among the Indians whom they may meet, and because it has deprived us of the information I was in hopes of deriving from them. I have given orders to the effect that if the like indiscreet act should be committed again the perpetrator would be held to a strict account for it, and should be punished to the extent of his crime. As I have before stated, my policy with the Indians has always been one, so far as it could be, of peace and good-will toward them; and I have never found anything but good resulting from it.

This morning I read service in front of my tent, and was glad to see a number present. This evening, before sundown, I ascended, with Messrs. Jagiello and McCarthy, the high peak to the northeast of our camp, for the purpose of viewing the surrounding country. The peak is probably about 1,500 feet above our camp. After some very considerable exertion, which, immediately after dinner, I found not so very easy, we attained the summit. On every hand could be seen high mountains; to the northeast, some 60 miles off, the Humboldt range; to the east the We-a-bah range we crossed, on the 19th; to the south, some isolated mountains, and to the west several ranges, the most distant ones covered with snow, and ranging apparently north and south. This Kobah Valley is the most extensive one we have seen, and, like the Great Salt Lake Desert, seems once to have been a lake. It seems to be filled with mountains, more or less extended, and running in a variety of directions, though generally north and south, and the valley extends around the points of these mountains, and, in some instances, runs off to an indefinite distance. Streams run from the sides of the mountains, toward the valleys, but sink in the alluvion at their base. They are generally grassed, particularly up in the cañons or ravines.

May 23, *Camp No.* 19, *She-o-wi-te, or Willow Creek.*—Morning cloudy and lowering. Thermometer at 5.30 a. m., 49°. The guide reports two passes, one north of west, and the other west of south. Neither is in the most direct line of approach to our ultimate point, but the latter is much the nearer of the two, and therefore we take it, bearing off, however, still more southwardly in order to certainly reach water within a reasonable distance. (We found, however, the next day that we could have taken a more direct course, (southwest,) as laid down on the map, and have saved about 10 miles. Wagons should take this latter course, which they will find practicable.)

Eight miles from camp ran a short distance parallel to a small stream, which sinks. Willows along it. Grass scant and alkaline. About 4 miles farther cross a wash or creek running southeast, the bed of which is 12 feet wide, and which at times must void a great deal of water, though at present it only exists in pools. Bunch-grass along it, but too alkaline for use. Two miles farther, pass, on our right, about a mile off, a mound, in which are some warm springs, one of them so warm as scarcely to admit the hand. The mound is the product of the springs, and is a calcareous tufa. Three and a half miles more brought us to a small spring, which I call after Private Shelton, of the dragoons, who found it, and who, besides being a soldier in appearance, is no less so in the thorough manner in which he executes the orders which are given him. No grass of any account about the spring, and not a sufficient quantity of water for the animals. They are consequently driven about 1.5 miles to the mountain slopes. Day's travel, 17.5 miles. Road good. Soil argillaceous and covered with sage and greasewood.

In cleaning out the spring, where we have encamped, the bones of a human being were found far-gone in decomposition. This is corroborative of the statement of my guide, last fall, that the Indians of this region bury their dead frequently in springs. It may be imagined that those who had drunk of the water did not feel very comfortable after the discovery. Fortunately for my mess the cook had used the water from the kegs which had been filled at the last camp. We were thus freed from the consciousness of having done an unpleasant thing. (On my return route, we found numerous springs in this valley to the north of, and not far from, our present camp.) Two more men on sick-list. All improving, except Clarke.

May 24, *Camp. No.* 20, *Shelton's Spring.*—Altitude above the sea, 5,993 feet. Thermometer at 5 a. m., 41°. Pete came in this morning, having traveled all night to pilot us to the next camping-place. In consequence of our having made a longer march yesterday than the guide thought we should, our to-day's travel will be only about 7 miles. Our course lay south of west, through a pass at the foot of Antelope Mountain, and continues over the foot-hills on the north side of the same, to a rushing stream, 3 feet wide and 1 deep, where, at 9.15 a. m., among the foot-hills, we encamp, in good grass and abundant cedar timber. This stream, which the Diggers call Wonst-in-dam-me (Antelope) Creek, coming from a high mountain, is doubtless constant, and, indeed, the Indians so represent it. The mountain from which it flows is magnificently serrated, and can well be distinguished by this peculiarity and its many cones. Several other streams course down its sides and sink in the valley after running a mile or two. Abundant grass can be found along the streams high up and on the cañon.

These mountains are of a different kind from those we have crossed since leaving Short-Cut Pass. The latter have been mostly of a sedimentary character, tilted as far as the We-a-bah range, generally to the west. Since then they have tilted toward the east. These rocks have in many instances been altered by heat, but not sufficiently so to come strictly under the classification of metamorphic rocks. Those we have passed through to-day, however, are decidedly igneous, though stratified rocks, some of them semifused and metamorphosed, have also been seen.

To-day on the route passes could be seen in the mountain-range to the east of us, which may be useful on our return. Colonel Cooper's Peak, on account of its cone-like shape and isolated position, has been all day a very conspicuous object. Journey 7 miles. Road hilly, but good. Some beautiful cacti, of hemispherical shape and covered with buds, seen to-day. Another man reported sick.

The weather for the past two days has been very bracing, and the effects of it are an alacrity in the men to their work, a general hilarity of conversation, and sports of different kinds in camp. This morning, after reaching camp, my assistants and myself have been practicing with the lasso or lariat. The Mexican herders with us and Indian Pete are so expert at it and useful in capturing two or three of our mules, which could not be otherwise caught, as to make us feel the value of the accomplishment.

In this country, where the bunch-grass prevails, the animals of a train should never be picketed, but be allowed to rove freely for grass, under the guidance and control of the herders. All of our animals are free from halters or lariats, and in the morning, when they are driven into camp, the teamsters have no difficulty in catching each his own mules. If you have wagons enough, however, it saves time to drive them into a corral made of them and connecting-ropes.

Our little camp, made up of four wall-tents, three Sibley's, and three common tents, with our twelve covered wagons and two spring or instrument wagons, with all the appurtenances of living men and animals, constitute quite a picturesque scene.

May 25, *Camp No.* 21, *Wons-in-dam-me, or Antelope, Creek.*—Altitude above the sea, 6,595 feet. Longitude, 116° 39′ 12″; latitude, 39° 29′ 13″. Thermometer at 4½ a. m., 22°. Ice in the buckets this morning. Sky clear and bright. Course westwardly, over a shoot or branch of Kobah Valley. In 4.3 miles cross Saw-wid Creek, a rapid stream, 3 feet wide and 1 deep, which comes from the Antelope Mountains, on our left, and sinks 500 yards below our crossing. Fine grass upon it toward the mountains. This branch of Kobah Valley, partially shut in at the south by a low range 8 miles off, but shows passes to the southwest and also to the southeast. Colonel Cooper's Peak still conspicuous. Many signs of sage-hen and antelope in this valley. A herd of the latter seen. At 12 m. reach foot of range, on west side of valley, after a journey of 13.7 miles, and encamp on a small creek, which I call Clarke's Creek, after John Clarke, one of the men, and upon which, and in the cañons higher up in the mountains, is plenty of grass. Road good, except the difficulty of breaking down the stubby sage-bush. The sage we have daily to break through with our wagons ranges from 3 to 8 inches at butt. It can be seen from this that the constant recurrence of this kind of hinderance in the aggregate amounts to a great deal. Soil argillaceous. *Artemisia* the characteristic. Altitude of Kobah Valley above the sea, 6,210 feet.

The mountain-range immediately to our west is called by the Indians the *Pah-re-ah*, or Water Mountain, on account of the many streams which flow down its sides into Kobah Valley, and on them is to be seen an abundance of grass. As I have before remarked, this stream, or one to the north of it, can and ought to be struck directly by wagons from Camp No. 19, and thus some 10 miles saved. (See map.)

Some fifteen or twenty Diggers have come into camp. From these I have been enabled to get the names of some of the mountains and streams. They are the most lively, jocose Indians I have seen. Say two rats make a meal. Like rabbits better than rats, and antelope better than either, but cannot get the latter. Have no guns; use bow and arrow. They occasionally amuse us very much in their attempts to ride our mules, which are, however, so much frightened at their rabbit-skin dress as to cause them to run off with them. One of them from this cause caught to-day a tumble.

I have worn my great-coat all the morning, and at times found it not warm enough. The guide returned at 2 o'clock, and reports a good camp 15 to 18 miles ahead of us, at the east foot of the second range to the west of us.

May 26, *Camp No.* 22.—Altitude above the sea, 6,373 feet. Up to this morning fifteen persons, nearly one-fourth of the command, have reported sick. A portion, however, have been returned to duty. Morning fine, but cool. Thermometer at 5 a. m., 29°. Night sensibly colder than any we have had, caused, doubtless, by the vicinity of the snow mountains, the Pe-er-re-ah range, to the west of us. Our morning departure very exhilarating. The crack of the whip, the "gee! get up!" of the teamsters, the merry laugh, the sudden shout from the exuberance of spirits, the clinking of armor, the long array of civil, military, and economic *personnel*, in due order, moving with hope to our destined end, coupled with the bright, bracing morning, and, at times, twittering of birds, make our morning departure from camp very pleasing.

Skirt the foot of the Pah-re-ah Mountains; course, southwardly; the pass immediately back or west of camp, which would shorten the route considerably, not being practicable for wagons, though pack-animals can use it. In 2 miles commence turning gradually westward, and in 2 miles farther, up an easy wagon-grade, reach summit of pass. Altitude above the sea, 6,440 feet. From this pass the Pe-er-re-ah (meaning Big or High) Mountain appears directly before us, some 12 miles off, trending north and south. These mountains in solidity put you in mind of the Humboldt Mountains. They have been conspicuous for several days back.

The road down the west side of the Pah-re-ah range is carried on the ridge of the spur, which furnishes a passable grade, though that down the cañon is not bad, and is entirely practicable for wagons without work, though a little sidling.

The first rattlesnake I have seen on the route I passed within a foot or two of my horse. The taxidermist, Mr. McCarthy, secured him with his fingers by the neck, much to the astonishment of the men near.

After reaching, in 7 miles from summit of pass, the valley called Won-a-ho-nupe, we turned northwest diagonally across it to the pass, through the Pe-er-re-ah Mountains. In 10 miles from summit of pass, through the Pah-re-ah range, we came to a rapid creek (Won-a-ho-nupe), 8 or 10 feet wide, 1½ deep, and running southwardly between steep sand-banks, 15 feet high. In 4 miles more cross this stream at mouth of cañon, and encamp one-fourth of a mile above on the stream, in good grass and where cedar abounds. Journey, 18.2 miles. Road generally to-day very good; over the Pah-re-ah range a large portion of it rocky from the loose igneous rocks scattered over the ground. Notice ranging along the west slope of the Pah-re-ah range a number of columns of stone, doubtless put by the Indians as landmarks to guide them over this trackless region.

Won-a-ho-nupe Valley is from 9 to 12 miles wide. Soil areno-argillaceous, and is very thinly covered with *artemisia.* At the south it appears uninterrupted; at the north is closed by a low range, a few miles above where we enter the pass of the Pe-er-re-ah range, admitting, however, a road of easy grade into the next valley. Altitude of valley above the sea, 5,443 feet.

A number of antelope seen. Notice under a cedar near our camp a very large willow basket of conical shape, which would contain probably a bushel and a half. Concealed under the same cedar were a number of rolls of willow peeling nicely tied together; also faggots or bundles of peeled willow—the stock in trade of some industrious Digger. Directed they should not be disturbed.

May 27, *Camp No.* 23, *Won-a-ho-nupe Cañon.*—Altitude above the sea, 5,870 feet. Thermometer at 5 a. m., 37°. One herder reported sick. This makes sixteen on sick-list from commencement. The bugle having become bent, and therefore not serviceable, reveillé not as prompt as usual. Morning bright. Leave at 6.10 a. m. Course westwardly up the cañon. This cañon quite luxuriant with willow and grass, the latter appearing in places quite green. The *Ephedra pedunculata* also begins to be quite common. The stream in the cañon is quite pure, and I think there must be trout in it. The road is winding through the cañon, but of easy grade, the only bad places being the frequent crossings of the creek, which occasionally are somewhat boggy. At these places, and on some short ascents and descents, the men have been required to do some excavation and embankment. At 11 o'clock, after a journey of 4.9 miles, we come to a small lake and the cañon expands into a sort of park about 4 by 3 miles in area. The landscape here quite pretty and very unique for this country. After giving orders to go into camp upon this lake, I continued up the main stream expecting in about a mile to reach the summit. After riding 7 miles I had not reached the source of the stream, and the indications were that it came from a snow peak ahead, which was still quite 5 miles off. This stream comes from northwest by west magnetically, and is quite rapid, and continued quite copious as far as I went up it. There is a great deal of meadow along it, and bunch-grass on the sides of the mountains; the grade, as far as I went, was easy. It leading me, however, too far north, I returned to camp with the hope of a more direct pass being found more westwardly.

An old Digger has visited our camp and represents that we are the first white persons he has ever seen. He says there is a large number of Indians living around, but they had run away from fear of us. I asked him why he had not been afraid. He said he was so old that it was of no consequence if he did die. I told him to say to them that we would be always glad to see them, and whenever they saw white men always to approach them in a friendly way, and they would not be hurt. He has been around eating at the different messes, and at length had so gorged himself as to be unable to eat more until he had disgorged, when he went around again to renew the pleasure. I showed him my watch, the works of which he looked upon with a great deal of wonder. He said he would believe what I told him about the magnetic telegraph the next time he was told it. He is at least sixty years old, and says he never had a chief. I asked him if his country was a good one. He said it was. He liked it a good deal better than any other. I asked him why. Because, he said, it had a great many rats. I asked him if they ever quarreled about their rat country. He said they did. So it would appear that civilized nations are not the only people who go to war about their domains.

The guide and party left us this morning, and are to be absent two or three days in researches ahead. Pete returned this evening from this party and reports our pass to-morrow to be the one directly west from camp, as I had concluded from this afternoon's reconnaissance.

The lake we are on is several acres in extent. Ducks frequent it. The grass about it and along the creek is quite luxuriant, and expands in places into meadows of considerable area. Cedar is found on the heights. Should it ever become necessary to establish a post, say near the east entrance of Won-a-ho-nupe Cañon, the grass, water, and timber of this mountain-range would be amply sufficient, and fine granite building-stone could be found in the cañon.

The party has given my name to this lake, park, and pass; and also to the creek, but as it has been my rule to preserve the Indian names, whenever I can ascertain them, and Won-a-ho-nupe is the name of the creek, I shall continue so to call it.

For the past two days the ground has been so resplendent with flakes of mica of a golden hue as to constantly remind you how rich it would be in gold were the shining particles veritably such.

May 28, *Camp No.* 24, *Simpson's Park, Pe-er-re-ah range.*—Longitude, 116° 49′; latitude, 39° 30′ 32″. Altitude above the sea, 6,355 feet. Thermometer at 5 a. m., 30°. Morning somewhat cloudy. Renewed journey at 10 minutes to 6 a. m. Leave valley of Won-a-ho-nupe Creek and strike west for Simpson's Pass, which we reach by a very easy ascent in 4.7 miles; altitude above the sea, 7,104 feet. The grass in the pass very abundant and of the finest character. This fine mountain bunch-grass fattens and strengthens our animals like oats. The pass at summit is as much as a mile wide, and both backward and forward the views are beautiful. The mountains near our camp of May 25 are seen very conspicuously back of us; and ahead of us, limiting Reese Valley, which we are approaching, is a low range trending generally north and south, and beyond them a very high range covered with snow, called by the Indians the Se-day-e or Lookout Mountains. The Pe-er-re-ah Mountains, which we are now about to leave, are composed, up Won-a-ho-nupe Cañon, of quartzite, altered slates, and granite rocks; and near Simpson's Park the rocks are highly metamorphosed, semifused and stratified. At the pass they are granitic.

Descending from the summit of Simpson's Pass, west side, by not a very steep but sandy grade, and along a short sidling place, near foot of ravine, (which our wagons passed by use of ropes to upper side, but which will require some slight side-excavation when the route is improved,) in 2.8 miles reach Reese Valley, which, in 3.7 miles more, we traverse to Reese River; this we cross by ford, and in 2.6 miles more up the river, or southwardly, reach our camping ground. Fuel should be brought. Day's travel, 13.8 miles. Road generally good. The ravine on west side of Simpson's Pass is filled with a thorn-bush in full bloom, 2 to 3 feet high; blossoms like those of the crab-apple.

The valley in which we are encamped, as well as its creek, I call after Mr. Reese, our guide, who, with two other men, discovered it some years since in their peregrinations between Salt Lake City and Carson Valley. They gave it the name of New River; but as Mr. Reese has been of considerable service, and discovers very laudable zeal in examining the country ahead in our explorations, I have thought it is but just to call the river and valley after him. The Indian name of the river is Pang-que-o-whop-pe, or Fish Creek. Mr. Reese is now, for the first time, on ground he has been once over, but confesses it has been so long ago it does not appear familiar to him.

Reese River is 10 feet wide, 1½ deep; current moderate; water good, though of a slight milky color from sediment; runs northwardly, and is the largest stream we have seen this side of the Jordan. Trout weighing 2½ pounds are found in it. The grass along it is luxuriant, but in many places alkaline. It is best and very abundant farther up the stream, and extends as far as the eye can reach.

Reese Valley is from 10 to 15 miles wide; at the north appears uninterrupted; at the south seems to be bounded by a range of mountains 30 miles off. Next to Spring Valley, it is the whitest with alkaline efflorescence we have seen. Soil argillo-arenaceous and covered with the wild sage and greasewood. It is quite well watered, and several streams well grassed can be seen tending to it from the west slope of the Pe-er-re-ah range. Altitude above the sea, by barometric measurement, 5,530 feet.

Sanchez returned from guide's party this afternoon, and reports next camp about 22.5 miles off.

May 29, *Camp No.* 25, *Reese River.*—Altitude above the sea, 5,563 feet. Magnetic variation, 16° 10′ E. Thermometer at 4.50 a. m., 22°.5. Intended spending the Sabbath here, but the grass not being of the best kind, think it best to move. Morning lovely, though cool. The mules more and more difficult to catch up; attribute it to the improved condition, caused by the nutritious properties of the mountain bunch-grass. Moved at 5 minutes to 6 a. m. Course southwestwardly, to a depression or pass of the low range bounding Reese Valley on its west side, which we reach by an easy grade in 13.5 miles. Altitude above the sea, 6,483 feet. This pass is remarkable on account of the igneous, reddish rocks about it, several of them appearing in the form of peaks, domes, and knobs. These are semifused, stratified, and porphyritic rocks. Notice a very small spring to the left of the road, just before reaching summit. The recent foot-prints of Indians leading to it show that they cannot be far from us. The water is doubtless not constant.

From summit of pass see another valley to the west of us, ranging generally north and south, and bounded by the Se-day-e or Lookout range, on its west side In 2 miles from summit reach west foot of pass in valley by a tolerable descent, and without difficulty.

This valley is exceedingly forbidding in appearance. To the south the bottom is an extended clay flat, perfectly divested of vegetation, terminating toward the south in a small lake. In the distance it all looked so much like a sheet of water that I sent a dragoon ahead to examine it; but, with my spy-glass, seeing him gallop over it, I concluded it was passable; so gave the word forward. I struck magnetically S. 60° W., to the green spot across the valley Sanchez pointed out as our camp-ground, and on going to it passed over a portion of the clay flat referred to. In its checkered and smooth state it put me in mind of a polished tesselated floor. Clouds of dust, like smoke, could be seen eddying over it in different directions. In 5.8 miles from foot of pass, at 3½ p. m., after a journey of 21.2 miles, come to a creek, where we encamp in tolerable grass. The creek is 5 feet wide, 2 deep, and, running with considerable rapidity, spreads out in many rills, and sinks in the lake referred to. Abundant grass can be found at the mouth of the cañon of this stream. Both the stream and cañon I call after my assistant, Lieut. J. L. Kirby Smith.

This valley, which I call after Capt. I. C. Woodruff, Corps Topographical Engineers, is 10 to 15 miles wide, and closed partially at the north by a pretty high mountain, some 12 miles off, and at the south by a range which seems to admit of egress at the southeast and also the southwest angle. Its altitude above the sea is 6,000 feet. Road to-day in Reese Valley, for 2 miles from camp, heavy; remainder good, except a little rough going down from the pass in the valley, on account of some gullies. A couple of wolves noticed in the vicinity of camp, the first we have seen.

May 30, *Camp No.* 26, *Smith's Creek, Woodruff Valley.*—Elevation above the sea, 5,960 feet. Thermometer at sunrise, 35°. Our guide told Sanchez before leaving him day before yesterday that he would meet us at this camp last evening. This he has not done; and as he is alone, contrary to my orders, which require him always to come in with the last man of his party, I am not gratified, though doubtless his zeal has led him to this unauthorized venture. We have therefore remained in camp to-day on his account. Meantime I sent out Pete, Payte, and Sanchez to examine the pass directly to our west, up Smith's Creek, and they have returned and report it impracticable for wagons without a great deal of bridging and other work. (The diary of my return route will show, however, that on our return we got through this pass without any great difficulty; and though some work is necessary to make the road through it what it should be, yet in grade it was far better, though 4 miles farther, than by the way of the pass to the south of it, which we took in our outward route.)

Payte and party report they saw Diggers in the mountains to the west of us to-day, but that they fled as soon as they were perceived. They found one little fellow, about four years of age, hid behind a sage-bush, but as soon as their backs were turned the youngster put off as fast as his legs would carry him.

On our return we ascertained that the Pe-er-re-ah range, which we crossed on the 28th, is the boundary between the Sho-sho-nee Diggers (or what has been called, as I think erroneously, the Pah-utes) and the Pi-utes, as the Un-go-we-ah range seems to be the boundary between the Sho-sho-nee Diggers and the Go-shoots. Why the Pah-utes should have been thus called I am at a loss to comprehend, for their language is Sho-sho-nee, and not Ute, and, therefore, they are more certainly a people derived from, or cognate with, that tribe than the Ute. I also notice that the Pi-utes and Pah-utes are designated on the maps as one and the same people. This is also a mistake, and doubtless has arisen from similarity of their names. They are all, however, more or less Diggers; that is, they live on roots, rats, lizards, insects, grass-seeds, &c.

May 31, *Camp No.* 26, *Smith's Creek.*—Thermometer at 5.20 a. m., 29°. Mr. Reese, the guide, not returning last night, I have thought it expedient to send out Payte to explore to the south and west, giving him special instructions in the premises, so that in case any accident may have happened to Mr. Reese we may at once move forward to his rescue. Pete and Sanchez and two dragoons accompany him. He is to keep me advised daily of the proper places to encamp ahead. The party take three days' provisions. One of the party returned at 1 o'clock, and reported grass and water 10 miles ahead, in a southwest direction, and a pass near, which looked favorably for crossing the Se-day-e range.

June 1, *Camp No.* 26, *Smith's Creek.*—Thermometer at 5.25 a. m., 30°. Mr. Reese has not yet made his appearance. I feel quite anxious about him, as he is entirely alone. He has hitherto been very prompt in fulfilling his engagements, riding sometimes late at night, and, on one occasion, all night, to effect it. I therefore have sent out Mr. McCarthy and two dragoons to track him, and at the same time have ordered the whole party forward to the water and grass reported yesterday. This is in the direction in which he told Sanchez he would cross the next, or Se-day-e, Mountain.

Just after commencing the march, I noticed apparently an old, decrepit-looking man approaching the train from the west side, and supporting himself by a couple of crutches or sticks. At first I took him for a Digger Indian. On more close scrutiny, however, I found it to be Mr. Reese, our guide, who, as soon as we reached him, sank down exhausted into a sage-bush. His clothes were nearly torn off him, and altogether he presented a most pitiable aspect. As soon as he could collect his mind he informed us that the day before yesterday, when on the other or west side of the Se-day-e Mountains, about 17 miles off, his mule gave out, and that he has ever since been on foot, trudging over the mountains to find us. He had no clothing except what he had on his back, and as he had lost his matches he could make no fire, though the night was quite cold. He had lost his haversack of provisions, and the consequence was that he had had nothing to eat. Some Digger Indians he met kindly offered him three fat rats, but as they had been roasted with entrails and offal unremoved, he said he did not feel hungry enough to accept their generous hospitality. We were exceedingly glad to see him, and had him supplied with something to eat, after which he went to sleep in one of the wagons. Finding him safe, I sent a dragoon to notify Mr. McCarthy and party of the fact, and direct their return.

Our course to-day has been magnetically S. 25° W., between the base of the Se-day-e range on our right and the clay flat and small lake of Woodruff Valley on our left. In 1.6 miles from camp cross a fine rapid stream, 5 feet wide, 2 deep, bottom somewhat soft, which I called after Mr. Engelmann, the geologist of my party. It expends itself in the lake. Two and a half miles farther cross another small stream running in the same direction, and after a day's march of 10.2 miles come to a swift creek running east from the mountains, which I call after Lieutenant Putnam, Topographical Engineers, one of my assistants. It is 6 feet wide, 2 deep, and of gravelly bottom. After running 5 or 6 miles it expends itself in the small lake before referred to. Willows line it. Soil of Woodruff Valley argillaceous, benches gravelly. The *artemisia* the characteristic. Cedars cover the mountains near.

Payte with party returned to camp just after we had pitched our tents, and reports a pass 10 miles south of this, which he thinks, without considerable work, impracticable, and says it looks very steep on the other side. There is, however, a practicable pass 20 miles south of us, but as after we get through it, according to him, we will have to go 20 miles more before we can get water, I have determined to go and look myself for a pass, Lieutenant Murry, Mr. Jagiello, Payte, and Pete accompanying me.

8.30 *o'clock p. m.*—Just returned from a reconnaissance of a pass, the foot of which is 2 miles southwest from camp. Started from camp at 2.30, returned at 8.30, just after tattoo; distance traveled about 24 miles. Found the pass on the east side of the mountain quite steep, and that on the west side quite rough, on account of the rocks and of the stream which passes down it. Think, however, it practicable, with some labor, and shall therefore attempt it to-morrow.

Lieutenant Putnam reports the cañon of Putnam's Creek, north of west from camp, for 2½ miles so narrow as to make it perfectly impracticable for wagons without a great deal of excavation, revetting, and blasting.

June 2, *Camp No.* 27, *Putnam's Creek.*—Longitude, 117° 27′ 34″; latitude, 39° 14′ 13″. Elevation above the sea, 6,325 feet. Thermometer at 5 a. m., 48°. Moved at 5 minutes of 6 a. m. Course southwestwardly to the base of the Se-day-e Mountain, and then generally westwardly through what I call the Gibraltar (or south) Pass, examined by me yesterday. The teams reached summit of pass, 5 miles from last camp, at 10 o'clock, without doubling. The only exceedingly steep place is about three-fourths of a mile up, where the ravine is left and a minor ridge surmounted to get over into the south branch of Putnam's Creek. The ascent of this minor ridge is steep, and the descent on the west side still more so. To accomplish the latter without accident we had to lock and rough-shoe the wheels. A good grade is possible, with the labor of some twenty men one day, on left side of track. Two and one-half miles thence up Putnam's Creek by a good grade brought us to summit of pass, 7,741 feet above the sea, and 3.7 miles more down Gibraltar Creek (a small stream) to a point in the cañon, where, at half past 4, we encamped. The road on the west side of the pass is very rough, on account of its frequent crossings of Gibraltar Creek and large, loose rocks scattered around, but by bridging the creek and removing the rocks—no very great work—it could be made good. Met with two upsets, and the breaking of a wagon-tongue, hound, and coupling in this cañon.

On right of cañon, descending from summit, some stupendous granitic and porphyritic rocks, probably 500 feet above the valley, are noticeable. Journey 8.7 miles. I continued 7 miles farther down the cañon to examine it, returning about 9 o'clock p. m., and finding the command uneasy about me, as I was alone. The guide, Mr. Reese, found his mule where he had left him the other day, saddle and everything safe.

The cañons of this mountain abound in pure water and splendid grass. The mountain-mahogany is also seen. Cedar and pines are also found, as they have been in nearly every range since we left the Great Salt Lake Desert. These cedars branch immediately from the ground, are 12 or 15 feet high, and present in the mass a rotund form. The pines are generally on the summits of the ridges, and are generally not more than 25 or 30 feet, though some attain a height of 50.

The rocks of the Se-day-e Mountain are porphyritic and trachytic, also semifused stratified rocks. West of summit they are white granite, lower down red and brown porphyritic rocks.

June 3, *Camp No.* 28, *Gibraltar Creek.*—Thermometer at 5.10 a. m., 48°. Morning pleasantly cool, and as usual clear. Mr. Reese, with Pete, Sanchez, and two dragoons, left this morning to be absent for several days, probably four or five, to examine the country in advance, and keep me advised daily of route and camping-places. Raised camp at 6.15, and continued down Gibraltar Cañon. For about a mile it continued rough from isolated rocks; after this no difficulty. Creek sinks 1.7 miles below camp. Five and a half miles farther strike a small creek and a spring, which might be called an extension or re-appearance of Gibraltar Creek, though strictly it is a continuation of its more northern branch, which comes in from the mountain at this point. Half a mile farther pass through a gap or gate between some stupendous rocks of a dark-gray and brown porphyritic character, which form a range of narrow breadth perpendicular to our course. This defile from the cañon to the valley I call the Gate of Gibraltar. It is about 50 yards wide, and of champaign character. From this gate, following the course of Gibraltar Creek (very small) in a southwest direction, we cross in 7.2 miles a valley or plain, and arrive at a second gate or gap in a low range, running north and south, where, at 4 p. m., we encamp near the sink of Gibraltar Creek. A limited amount of grass is found at the gap; more in vicinity on west side. The mountain range which crosses here is perfectly devoid of timber. Road to-day rough, the first 2 miles down Gibraltar Cañon, and subsequently somewhat soft on account of the pulverulent character of the soil of the valley to the west of the Se-day-e range. This valley, along the route, is quite a desert one, scattering greasewood and the wild sage being the principal growth.

On reaching our camping-place, which I call the Middle Gate, saw a naked Indian stretched out on the rocks at an angle of about 20 degrees. He was so much of the color of the rocks as to escape our notice for some time. On being aroused he looked a little astonished to see so many armed men about him, but soon felt assured of safety by their kind treatment. He seemed particularly pleased when he saw the long string of wagons coming in, and laughed outright for joy. I counted twenty-seven rats and one lizard lying about him, which he had killed for food. He had with him his appliances for making fire. They consisted simply of a piece of hard greasewood, about 2 feet long, and of the size or smaller than your little finger in cross-section. This was rounded at the but. Then a second flat piece of the same kind of wood, 6 inches long by 1 broad and ½ thick. This second piece had a number of semi-spherical cavities on one of its faces. With this piece laid on the ground, the cavities uppermost, he placed the other stick between the palms of his hands, and with one end of the latter in a cavity, and holding the stick in a vertical position, he would roll it rapidly forward and back, till the friction would cause the tinder, which he had placed against the foot of the stick in the cavity, to ignite. In this way I saw him produce fire in a few seconds.

After sundown a Pi-ute Indian, the first we have met, came into camp, habited in a new hickory (coarse check) shirt, doubtless of the stock I gave the guide this morning, as presents to the Indians for information and guidance to water and grass. The shirt is most probably the credentials of his office as guide to us to-morrow, besides, his gestures (Pete is away and we therefore cannot talk to him) seem to indicate the same thing. In addition, the guide has sent no dragoon back, as directed, and this seems to confirm our suspicions that he has been sent to us as a guide. Dr Baily reports only one person on the sick-list, Mr. Jagiello. The day has been oppressively hot, and everything indicates that, from the Se-day-e range, we have descended to a lower level of altitude than we have experienced at any time along the route. The mountains, too, appear lower, and are entirely free from snow; the general face of the country is very arid and forbidding. The men had hard work to pitch our tents on account of the high wind and dust.

June 4, *Camp No.* 29, *Middle Gate.*—Elevation above the sea, 4,665 feet. For the first time it was so warm last night that I slept under a single comforter. Heretofore I could scarcely make myself warm enough with all the bed-clothing I could muster. Thermometer at 5 a. m., 38°. Morning clear and pleasant. Moved at 6. Our new Indian guide cut an amusing figure in attempting to mount his mule. He rides by clinging to the pommel of the saddle. Immediately after passing through Middle Gate, strike southwestwardly over a pulverulent prairie to a third gate, which we reach in 3½ miles, and which I call the West Gate. It is also a gap in a low range of mountains running north and south. After threading this defile, pass over another thirsty-looking, marly prairie, surrounded by low, ashy-looking mountains, with passes between. In 5 miles get across this valley, and attain summit of a low ridge, whence we descend to another shallow valley, altitude above the sea 4,090 feet, which I call

Dry Flat Valley, on account of the whitish clay flat we cross, and which is as smooth and as hard as a floor. Indeed, the glare from it was almost blinding. Twenty miles from camp we attain the summit of the range dividing Dry from a valley I call Alkaline Valley, on account of its general whitish alkaline appearance from saline efflorescence. Descending this ridge 1.7 miles, and turning northwardly and skirting it for 2.7 miles, we come to our camp-ground, where the guide party, which is in advance of us, has dug a number of small wells.

The water is found in an efflorescent sand-flat, and lies 3 feet below the surface. In some of the holes it is strongly alkaline; in others just tolerable. The addition of vinegar improves it very much. It is, however, difficult to keep up a supply of water on account of the sand tumbling in. The grass in the vicinity is very alkaline and scant, and altogether this is a miserable camping-place, the worst we have had. Fuel, rabbit-bush, a miserable substitute for the sage or greasewood.

The wagons reached camp at half past 4. Journey, 24.5 miles. Road pretty good. Country very arid and desert. Mountains in the distance perfectly devoid of timber, and of a thirsty, ashy hue, except the last range we crossed, which is of a dark-brown appearance, approaching black, and therefore called Black Mountains. The rocks at our morning's camp, Middle Gate, are porphyritic; westward of these as far as the Black Mountains, first quartzite, and then highly altered stratified rock, siliceous limestones, slates, dolomite. The Black Mountains are made up of partly strongly-metamorphosedst, ratified rocks and partly igneous and scoriaceous, lava-like rocks traversed by quartz-veins.

The day has been very hot, and we have all felt very thirsty; not knowing when we started that water would be so far off, we had not taken the precaution which we should have done to have our water-kegs filled at Gibraltar Cañon. Our great thirst over these desert plains is no doubt owing to the dry condition of the atmosphere, which favors the rapid dessication or drying up of the humors of the body.

On the route, one of the dragoons returned from the guide's party with a note from Mr. Reese, informing me of the locality of to-night's camp, and giving the unpalatable news that the water was not good, the grass poor, and that we were within 12 miles of the north end of Walker's Lake, where we would encamp to-morrow. The consequence is, that as the point I have been aiming at is the north bend of Walker's River, and not the Lake, we are a great deal too far to the south, and must therefore make the necessary corresponding northing. This error could only have occurred on the supposition of Walker's Lake being wrongly placed on the Topographical Bureau map, for I feel confident that the latitudes which I have worked out, and upon which we have based our southing, have been correct. If Mr. Reese had not assured me that he had been over this portion of the country before, I should doubt the truth of his representations; but, relying on the accuracy of his observations, we are obliged to change our course from our present camp in a northwest direction in order to reach in the most direct way the north bend of Walker's River.

June 5, *Camp No.* 30, *Alkaline Valley.*—Altitude above the sea, 3,900 feet. Thermometer at 3.30 a. m., 48°. Up at half past 3 a. m., but in consequence of mules straying off to get grass and water, the train did not move until 5. Course north of west, along west foot of Black Mountains, to the north end of what turned out to be Carson instead of Walker's Lake. The guide, therefore, at fault, and neither the Topographical Bureau map nor my calculations wrong. As the map will indicate, it will be perceived that before I made the turn to the northwest, pursuant to the representation of our whereabouts by our guide, my course was direct for the bend of Walker's River, the locality aimed at from the commencement of the expedition at Camp Floyd. The consequence is that we have lost about 12 miles by our guide's errors, and will have to retrogade, for a distance, our steps.

The road to-day has been along the east edge of Alkaline Valley, and the west foot of the Black Mountains. In the valley it has been heavy, and on the benches, on account of the basaltic rocks, rough. The valley, which is almost everywhere white with saline incrustation, is about 16 miles long and 8 broad, and in wet weather must cut up a great deal. The mountains inclosing it are low, and give indications of passes in almost every direction. Not a sign of a tree is to be seen on any of them. The Sierra Nevada, seen for the first time to the west of us, some 60 or 70 miles off, is covered with snow. Journey, 16.6 miles. Teams got in at 12 meridian. O the luxury of good sweet water to a thoroughly thirsty traveler! How little do we value the daily common bounties of Providence! For the past few days a draught of pure cold water has been prized at its true value; and it is only the real absence of our comforts that causes us to estimate them at their full value.

We are encamped at the head of the outlet from Carson Lake into the sink of Carson, where our only fuel is dry rush. This outlet is about 50 feet wide and 3 or 4 feet deep, and voids the lake rapidly into its sink, which is some 10 or 15 miles to the northeast of us. The water is of a rather whitish, milky cast, and though not very lively, is yet quite good. The Carson River to the northwest, where it empties into the lake, can be seen quite distinctly, marked out by its line of green cottonwoods.

The name of the river and lake was given by Colonel Frémont, in compliment to Kit Carson, one of his celebrated guides.

The alluvial bottom about Carson Lake is quite extensive and rich, as the luxuriant growth of rushes shows, and could, I think, be easily irrigated. The only drawback to its being unexceptionable for cultivation in every part is its being somewhat alkaline in places, particularly toward its southern portion. Curlew, pelican, and ducks, and other aquatic birds frequent the locality, and the lake is filled with fish. A number of Pi-utes, some two dozen, live near our camp, and I notice they have piles of fish lying about drying, principally chubs and mullet. They catch them with a seine. Their habitation consists of flimsy sheds, made of rushes, which screen them from the sun and wind. They present a better appearance than the Diggers we have seen, both in respect to clothing and features. Indeed, they act as if they had been in contact with civilization, and had to some degree been improved by it. The decoy-ducks they use on the lake to attract the live ducks are perfect in form and fabric, and I have obtained a couple for the Smithsonian Institution.

This valley of Carson Lake presents at sunset a very pretty landscape. It lies very level, and on every side, at a considerable distance, with intervals between, are very pretty blue mountains lying along the horizon, giving variety to the picture. The air this afternoon has been also very soft and balmy, having a tranquilizing effect on the senses and inducing one to drink in with delight what lies before him.

Pete, whom I found at camp, and had sent out to bring in the rest of the guide's party, returned at 6 p. m., bringing with him the infantry soldier, Sanchez, and the pack-mule. He missed the track of Mr. Reese, who will be in to-night, probably, or to-morrow. The Pi-ute with the check shirt accompanied us all the way to our present camp. In mounting his mule, he invariably would protrude his legs through and between his arms while resting his hands on the saddle, and in one instance, in his attempt to mount in this way, awkwardly tumbled off on the other side.

June 6, *Camp No.* 31, *north end of Carson Lake.*—Longitude, 118° 30′ 01″; latitude, 39° 23′ 37″; altitude above the sea, 3,840 feet; thermometer at 4.45 a. m., 43½°. Mr. Reese returned during the night. The Indians in camp early this morning, with fish to barter in exchange for old clothing, powder, &c. Seem to be pretty keen in a trade about small things; but in larger matters—as, for instance, the barter of a child—one of the Indians said he would sell his, a lad of about 8 years of age, for a jackknife. They seem to be perfectly beside themselves at the idea of a train of wagons passing through their settlement. Nothing of the kind has ever occurred before. They laugh and jabber like so many parrots, and it has been difficult to get any distinct notions from them about the country in advance of us.

We retrograde to-day in our course, southerly direction, and skirt the east shore of Carson Lake. Air balmy and throwing a blue veil over the near and distant mountains. The snowy peaks of the Sierra Nevada seen on our right; the water of Carson Lake beautifully blue; lake margined with rushes; the shores are covered with muscle-shells; pelicans and other aquatic fowl a characteristic. Upper half, that is, north half, of east margin of Carson Lake very slightly alkaline. South half, east margin, white with alkali. Indeed, as I proceed I find that the margin of the lake generally, as far as I can see, looks alkaline. In 9.7 miles leave the lake at its southern end, and, passing over and through some sand-hills, in 5.7 miles come to a small spring of calcareous water, where there is no grass. Here there has been a number of these springs, and the locality for a very considerable area is nothing but calcareous tufa, formed by the springs, which are all closed but one. Three miles more brought us through some heavy sand-drifts to a very small spring of miserable mineral-water, so nauseous as not to permit me to take even a swallow. No grass in vicinity. After proceeding a few miles further, in consequence of the day being very warm and the sand-hills heavy, halted at 3 o'clock, and turned out the animals to graze upon the little grass which exists in bunches around. At 5 start again, and, still ascending to crest of dividing ridge between Walker's Lake Valley and Saleratus Valley, in 9.4 miles reach summit, 4,595 feet above the sea. Just before doing so, Lieutenant Murry sent word that some of the mules were giving out, and he was afraid he would be obliged to halt. I sent word back to him to try and hold on till he could reach the summit, and after that there would be no difficulty. He managed, by exchanging some of the mules, to get the wagons all up to the top of the divide, but it was midnight before we reached Walker's River, 6.9 miles distant, and as the night was quite dark, we considered ourselves very fortunate that we got along without accident. Some of the party were so fagged out on reaching the camp-ground as to immediately roll themselves in their blankets on the ground and go to sleep. We find ourselves on (for this country) a noble river, but will have to await daylight to disclose its features; perceive, however, we are amid good grass and timber and have an abundance of water. Journey to-day a hard one. Country wretchedly sandy and barren, mountainous or hilly. Distance, 31.2 miles. The guide has been a Pi-Ute Indian, hired at Carson Lake. The formations along the route have been trachytic, scoriatic rocks and volcanic tufas. In the pass, just before attaining summit of divide, noticed some hieroglyphics on detached bowlders.

June 7, *Camp No.* 32, *Walker's River.*—Altitude above the sea, 4,072 feet; thermometer at 7.30 a. m., 69°. In consequence of getting into camp so late last evening, and the teams requiring rest, we lay over at this point till this afternoon. The river we are encamped on (Walker's) is the largest I have yet seen this side of Green River; is about one hundred yards wide and from six to ten feet deep at its present stage, which seems to be high. It flows quite strongly toward Walker's Lake, in which it sinks. Its color is very much like that of the Missouri (a rather dirty yellow), and in taste is quite soft and palatable. Its banks, which are vertical, are about four feet above the surface of the water. The name Walker, applied to this river and to the lake into which it flows, first appears on Frémont's map of 1848, and was doubtless given by him in honor of Mr. Joseph Walker, the leader of the party sent by Colonel Bonneville, in 1835, to explore Great Salt Lake, and who subsequently, on his way to Monterey, Cal., passed by this river. Walker, after this, in 1845, was Frémont's guide along this same river and lake.

I have sent Mr. Reese ahead with a few men to construct a raft to enable the party to cross Carson River when we shall reach it. After attending to this, he is to proceed on to Genoa and bring back our mail. Some Pi-Utes from Walker's Lake have come into camp to sell or trade salmon-trout, caught in the lake. The largest they have weighs about 20 pounds. These Indians talk a little English and dress, some of them, like white people. In condition they are superior to those we have seen.

Raise camp at 3 p. m. Sun scorching hot. Course northwestwardly along the left or north bank of the river, being forced occasionally by the river from the bottom to the sand-bench. River-bottom from one-fourth to one-half mile wide. Soil, a dark loam, very rich. Grass quite abundant and of good quality. Cottonwoods (sparsely) and willows (abundantly) fringe the river. The river-bottom could be readily and copiously irrigated and made very productive. A range of low mountains run parallel to the river on north, and another also on south side, each about eight or ten miles distant. Not a tree or shrub is to be seen on them. The contrast between the perfectly barren, sandy, thirsty-looking country to be seen on every side and the valley of Walker's River, fringed with green cottonwoods and willows, very refreshing. After marching ten miles, at 7 o'clock encamped again on the river. Road good except on banks of valley, where it was sandy. Pete came in from guide's party, and reports bend of Walker's River six miles ahead, where I expect to camp to-morrow.

June 8, *Camp No.* 33, *Walker's River.*—Longitude, 118° 49′ 00″; latitude, 39° 07′

38″; altitude above the sea, 4,200 feet; thermometer at 4.45 a. m., 53°. Morning, as usual since we crossed the Se-day-e Mountains, oppressively warm immediately after sunrise. Moved at twenty minutes after 5. Continue 6.3 miles up valley of Walker's River, as far as the North Bend, and, at 8 a. m., encamp in tolerable grass. Road good, except the sandy portion wherever we left the bed of the river. Characteristics of country same as yesterday.

June 9, *Camp No.* 34, *North Bend of Walker's River.*—Elevation above the sea, 4,288 feet; thermometer at 4.25 a. m., 52°. Morning clear and pleasant. The Mexican, Sanchez, did not come in last night from guide's party to show us the road to next camp. We shall, however, push ahead, a Pi-Ute with us offering himself as guide. Our course lies northwestwardly to Carson River. Just after leaving camp, Sanchez met us and presented a letter from the guide, as follows:

"PLEASANT GROVE, CARSON RIVER, *June* 8, 1859.

"Captain SIMPSON:

"SIR: All is right. Mr. Miller will build a raft that will take the wagons over, for $30. The logs have to be hauled some three miles. The people here feel pleased that you and your party are so near. It is now 12 o'clock, and I am ready to start for Genoa. I shall be back before you arrive, to ferry on the raft. Mr. Miller says he will have it done to-morrow night.

"Yours,

"J. REESE."

Six miles from camp we pass some hot and cold springs to left of road in valley. Thermometer rose to 165° when immersed in one of the hot springs. One of them is ten by twenty-five feet, and quite a stream flows from it. The water boils up at different points, and while it is of a sort of blue color in the body, along the margin it is a reddish-yellow color, doubtless caused by iron. The blue color is probably due to the sulphur it contains. It is the hottest spring I have seen, not excepting those near Salt Lake City. The valley, ever since we left our camp of this morning, has been exceedingly alkaline. Leaving the valley of Walker's River and striking for Carson River, we cross the point of a low mountain—ascent and descent good—and in three and one-half miles more get into an old wagon-road, which we follow. One mile more brings us to a cañon, which we thread, and in which we find a considerable patch of grass and rushes. In this cañon, on left side, fourteen miles from last camp, embowered among wild roses and willows, is a small spring of good, cool water, about which there is a little grass; a plenty of the latter one-half mile south. Two miles farther, pass over the steepest and roughest hill, or spur, we have seen. We would like to continue down the valley until we strike Carson River, and then turn up its valley to the left, and thus avoid this spur, but the height of the water prevents. At this hill we were detained two and one-half hours. All the teams had to double to get up, except Payte's, which seems thus far to carry off the meed of power and good management. Three miles more along and up Carson River upon its bank brought us to a good spot on the river, where we encamp in good grass.

Carson River at our camp about 100 yards wide, quite swift; depth, from ten to fifteen feet; color, somewhat whitish or clayey. The river-bottom is about one-fourth of a miles wide, very rich, and can be readily irrigated. At this time the banks are full, and in places overflowing; large cottonwoods, solitary and in groves, along it. Mosquitoes, for the first time in our exploration, troubled us on Carson Lake, and we have had them, much to our annoyance, ever since. The country to-day, between Walker's River and Carson River, miserably arid and worthless for agricultural purposes. No timber; greasewood the principal plant, and the largest I have seen six feet high and as many across its branches. Journey, 19 miles. Road good, except steep hill three miles back. Have noticed this side, or west, of Se-day-e Mountains, the dove. Trap, vesicular, and trachytic rocks; also metamorphic strata characterize the region between Walker and Carson Rivers. We are now in the gold-region.

June 10, *Camp No.* 35, *Carson River.*—Altitude above the sea, 4,200 feet. The mosquitoes were so troublesome last night on the river-bottom that some of the men went on the bluff and slept. Last remaining ox of six we brought with us from Camp Floyd shows, by his constantly bellowing, his sense of his loneliness. The others have been killed for beef. Thermometer at 4.35 a. m., 58°. Morning pleasant and clear. Moved at quarter of 5. Continue westward along south side of Carson River as far as opposite Pleasant Grove, where at 8 o'clock a. m. we arrive. Find the raft ready, made of cottonwood-trees of an old log-house belonging to Mr. Miller, the agent of the California Mail Company at this station, and which he has pulled down for the purpose. This point a good one for ferry or ford; banks on either side low and firm. By 5½ p. m. the wagons and property were rafted across safely, except one wagon, which unfortunately capsized, causing the loss of some $31 belonging to the driver, Payte, (as he said,) and some clothing, also three sets of harness. What I however grieve the most about is, that a portion of our *herbarium* has got soaking-wet. The mules were driven across. The men have worked hard and have been constantly in the water, and obliged frequently to swim. It was amusing to see the cook, Storer, throw away the coffee-pot he was bringing over on the raft, when it capsized, and plunge for his life into the stream. Fortunately, he, as well as the other fellow on the raft, could swim, and therefore there was no loss of persons. It was, however, very provoking to hear the teamster discover his *morale*, by the vociferation which he made just as he jumped from the raft: "Let her go; I am safe." This was the more so, as the fellow had been a great brag; but, like all such, his courage, as well as honesty, failed him just at the moment of trial and when it was really needed.

Journey to-day, 9 miles. Road in places stony. A mountain-range skirts the river on north side of river. Its geological character is probably metamorphic. Along the road the rocks have been porphyritic, trachytic, and vesicular.

We have now at Pleasant Grove, for the first time, got into the old Humboldt River and Carson Valley emigrant-road. The California Mail Company have a station here, under the charge of Mr. Miller, who occupies quite a good, weather-boarded house. The grove of cottonwoods near it give the place its name.

June 11, *Camp No.* 36, *Pleasant Grove.*—Elevation above the sea, 4,288 feet. Moved at quarter to 7. Immediately follow up the valley of Carson River, on its north side, the old emigrant-road, which is as well beaten as any in the States; our course, west of south; mountain-range continues parallel to road on north side, three miles off, and on south side of river there is another, five miles off. Notice along the road three claim-shanties, and some ditching for mining purposes.

After proceeding 7.4 miles from camp, come to China Town, on Carson River; elevation above the sea, 4,360 feet. This is a mining town of twelve houses, and contains about fifty Chinese. Including all engaged in mining in a vicinity of six miles, the population is about one hundred and fifty. Can clear at these diggings, called the Gold Cañon Flat Diggings, when there is water, from $5 to $8 per day per man. These diggings have been worked since 1852. The material is taken out of the ravine, or *arroya*, which is composed of sand and cobblestones, and the gold sifted from it by a "rocker" or "cradle." Quality of the gold-dust, $13 to the ounce.

There are some new diggings seven miles northwest from this place up Gold Cañon, which were commenced last April, and which yield an average of $15 per day to the hand, with the cradle. Two men have been known, with one rocker, to make in one day $155; quality, $12½ to the ounce. (It is in this vicinity that the late splendid discovery of silver-ore, called the Washoe mines, has been made.) The great difficulty is the want of water, and on this account the mines are worked only in winter. There is a talk of tapping Carson River high up, or Bigler Lake, and thus supplying the mines with water. A rocker is a simple cradle with a sieve, through which the material passes on water being thrown upon it and it is rocked. The "long tom" is one or more long troughs connected, and a sieve at the end and a lower receiver. In this trough the material and water are introduced and the gold collected all along, the finest on the lowest platform or receiver.

China Town has two stores, one recently kept by E. Sam, a Chinese, who was drowned the other day in attempting to ford Carson River on horseback, and the other by Keller & Cohen. I am indebted to Mr. Long, who is at present in charge of E. Sam's store, for the above information in relation to the mines of this region, and he has given me the prices of commodities, as follows: Sugar, 3 pounds for $1; coffee, 3 pounds for $1; beef, 17 and 18 cents per pound; bacon, 37½ cents per pound; potatoes, 8 cents per pound; flour, 16 cents; shoes, ordinary kind, $3; boots, (pegged,) $6 to $10; hickory shirts, $1.25; barley, 10 cents per pound; oats, 10 cents per pound; whisky, $3 per gallon. The timber they use is pine, and it is hauled twenty-five miles from Washoe Valley; cost at mill, $20 per thousand; at China Town, $40.

Mr. Long conducted me to a room where a couple of the principal Chinamen were smoking opium. They were reclining, facing each other, on a kind of platform, their head supported by a stool or bench. Between them was a lamp burning. They had a pipe of about two feet long, the bowl of it being two-thirds of the distance from the mouth-end. One or the other keeps the bowl, charged with opium, constantly applied to the lamp, and, drawing hard, passes the smoke through the nose and mouth. Mr. Long says $8 worth of opium will last two persons about six months. It stupefies, rather than enlivens, and, when indulged in excessively, perfectly paralyzes the energies.

He also showed me a room in which there were six of these fellows gambling. They have a large number of pieces, like dominos, and counters, and take a great deal of interest in the game; run through it with the greatest dexterity and rapidity. They are represented as being very fond of gambling when they have nothing else to do, and not unfrequently lose all their earnings in this way.

These Chinamen have the characteristic look of their nation, the tawny color and peculiar eyes; shave the hair clear around to the top of the head, giving a peculiar effect to the forehead, and let the balance fall behind in a tail or plait. Their foreheads are retreating; eyes, hazel; wear wide pants and ordinary hickory (check) shirts. There are no women at this place.

To proceed with route. At China Town we bear off somewhat from Carson River, one mile bringing us to forks of road; right leads to Johnstown, 1.5 miles off in Gold Cañon. Six miles farther up, in a branch of Gold Cañon, are the new rich gold-diggings referred to above. All along this emigrant-route, ever since we struck it, the bones of oxen attest the effects of the old Humboldt route, on account of poisonous water and grass along the Humboldt and desert, in destroying stock.

Four miles from China Town, cedars 15 to 20 feet high appear on either side of the road on the mountains and in the valley—the first we have seen since leaving the Se-day-e Mountains. Seven and one-half miles farther brings us to Carson City, in Eagle Valley, at the east foot of the Sierra Nevada, where, at 5 p. m., we encamp. The Sierra Nevada has appeared ahead of us to-day, towering high, covered with snow, and looking fine, covered as it is with tall pines from base to summit—a spectacle we have not seen before on the trip.

Carson City has about a dozen small frame houses; two stores—Major Ormsby proprietor of one. Eagle Valley, in which it is situated, is of small extent but very fertile. A small stream courses through it, a large portion of which is expended in irrigation. The location is a good one, on account of its proximity to the new diggings in Gold Cañon, (said to be the richest yet discovered,) about 7 miles off, and its commercial relations with Honey Lake and other valleys to the north. I am informed that this same system of fertile valleys lying between spurs from the Sierra Nevada, on its east side, continues for a very considerable distance both to the north and south of this valley. Road to-day, except over a couple of sloughs of narrow width, good. Journey, 19 miles. Spent a very agreeable evening at Major Ormsby's,* where I, for the first time since I left Camp Floyd, encountered the society of ladies. Mr. Crane, the former delegate to Washington in behalf of the claims of that section of country to a new Territory (Nevada), to be taken off from the western portion of Utah, was present.

June 12, *Camp No.* 37, *Carson City, Eagle Valley.*—Altitude above the sea, 4,587 feet. This morning at sunrise an overcoat not unpleasantly warm. Thermometer at 5 a. m., 44°. This camp-ground beautiful; the prospect the most pleasing and Eastern-States-like of any I have seen. It reminds me of a pastoral landscape of the lower Delaware, below Trenton. This is the first morning there has been dew on the grass sufficient to show on your boots.

Par parenthese.—Mr. Reese, who has repeatedly been over the old route by way of Humboldt River, says it is objectionable, on account of high water in the spring overflowing the valley and forcing the road on the bluffs, which are very sandy. This high water affects the road for about 150 miles along the Humboldt and Thousand Spring Valley. It is also objectionable on account of the bad water (alkaline) and alkaline grass, which extends along the lower part of the Humboldt for 75 miles, and on account of the desert between the sink of the Humboldt and the sink of Carson, and the scarcity of feed from Ragtown, on Carson River, to Big Bend of Carson, about 30 miles. Twenty-five per cent. of stock, he assures me, on the average, has been lost annually on the route from these causes. The Goose Creek and Bear River Mountains make it also useless in the winter, on account of snow, and the distance is greater than by my route. He also represents that all along the Humboldt, that is, for a distance of over 300 miles, there is no timber but small willows; none in Thousand Spring Valley, and none on Goose Creek. Poor prospect this for the magnetic telegraph. Whereas on this our outward route, except between the Champlin Mountains and the Go-shoot range (86 miles), and between the Se-day-e Mountains and Carson Lake (56 miles), the mountain-ranges are covered with pine, piñon, balsam, quaking ash, and mountain mahogany, all of which make the telegraph a feasible project, the maximum haul of the poles, except at the points stated, being not over 10 miles.*

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* This gentleman, I notice by the papers, has since been killed by the Pi-Utes, against whom he was operating with a party of citizens.

Leave Carson City at quarter past 5. Course southwardly, continuing on the old emigrant-road between the base of the Sierra Nevada and Carson River. In 3¼ miles cross Clear Creek, a beautiful stream running from the Sierra Nevada into Carson River. Nearly all these streams from the Sierra Nevada are so copious as to be ample for mill purposes, and the pines near (yellow and white or sugar) average probably 4 feet through, and sometimes attain, Mr. Reese assures me, a diameter of 10 and a height of 150 feet. Near Clear Creek approach again Carson River, and continue along it about 10 miles to Genoa. Noticed along the road the gallows on which the vigilance committee hung "Lucky Bill," last June or July, a reported horse-thief and murderer. Was astonished that the relic of such a season of popular agitation and excitement should be left to be harped upon by every passer-by. Notice, also, several farms along the road, a very common mode of fencing being the laying of single trunks of large pines in a line between the fields. The cattle look very fat, and sleek; hogs in like excellent condition. These latter are said to thrive on the roots of the tuilla or rush. The butter of this valley is of a rich gold color, and is said to command a higher price than the California butter.

This valley is good for the small cereals. Wheat and barley do well. Corn has been raised, but the birds and frosts generally destroy the crops; very little oats have been raised. A few peaches have been produced, but as yet no apples. Grapes have never been tried. All garden-vegetables, as also the strawberry, raspberry, and gooseberry, thrive. Potatoes are raised, but the cultivation of the sweet-potato has been a failure, and I am informed that they cannot be raised in California. The soil is generally irrigated. As a pastoral region it is superb. Cattle on the hoof command 10 cents per pound. Barley brings about $3 per bushel. The trade heretofore has consisted principally in exchanging goods with emigrants for their stock.

Reached Genoa at half past 9 a. m. Journey, 12.9 miles; road good. Just as we entered town, were saluted by the citizens with thirteen guns and the running up of the national flag, in honor of the party's having successfully accomplished the object of the exploration—the opening of a new and short road across the Great Basin from Camp Floyd, and thus facilitating the mails and emigration. Encamped among some giant pines at the foot of the Sierra Nevada, just upon the southern edge of the town, and on a gushing stream of pure water which courses down from the mountain. Our position is so high on the base of the mountain that we can overlook a large portion of the valley; and a beautiful one it is, fenced off, as it appears, into inclosures, and dotted with cattle. The sheen of the river (Carson), in its present high stage, discovers its course along the valley.

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* My return route in respect to timber generally along the route, and particularly on the deserts at either extreme, was found still better adapted to the telegraph.

For additional information in relation to the Humboldt River route, see Introduction, page 22.

Genoa, at the present time, has 28 dwelling-houses, 2 stores, 2 hotels, 1 printing establishment, and 1 electric-telegraph office. There are also in it and vicinity 2 grist-mills, 4 saw-mills, and 1 under way. Population, between 150 and 200. The town was commenced in 1855. It is now in connection, by electric telegraph, with San Francisco, 260 miles distant,* and, three days before we reached this place, our arrival at Walker's River had been announced in the papers of the Golden City. Indeed, we had no sooner arrived than I received a telegraphic dispatch from Col. Fred. A. Bee, the president of the Placerville and Saint Joseph's Overland Telegraph, inquiring about my route for the proposed telegraph across the continent. Replied that as I was going immediately to San Francisco, through Placerville, I would be happy to talk with him on the subject when I should meet him.

The Indian agent, Maj. Fred. Dodge, has called upon me, and extended all the civilities of a courteous and refined gentleman. He is the agent of the Pi-Ute and Washo tribes of Indians living in this region, and has politely furnished me with the following information in regard to them, which I give in his own language:

"The Pi-Ute nation number from 6,000 to 7,000 souls. They inhabit Western Utah from Oregon to New Mexico. They are divided into bands of about 200 strong each, commanded by a subchief. The head-chief of the nation is Wan-a-muc-a (the giver). The largest portion of the nation is generally to be found in the vicinity of the principal rivers and lakes of the Great Basin, viz, Humboldt, Carson, Walker, Truckee, Owen's, Pyramid, and Mono. The Pi-Utes resemble, in appearance, manner, and customs, the Delawares on our Missouri frontier, and with judicious management and assistance from the General Government, they would equal in three years their brother Delawares in agricultural or other advancements made by them toward civilization. The Pi-Utes are poor, but honestly inclined. They are also the most interesting and docile Indians on the continent.

"The Wa-sho nation number about 900 souls, and inhabit the country along the eastern slope of the Sierra Nevada from Honey Lake on the north to Clara River, a branch of Walker's, on the south, a distance of 150 miles. They are divided into three bands of about 300 each, commanded by three head-chiefs. Deer Dick's band is on the north, in the vicinity of Honey Lake and Long Valley; Captain Jim's band is in the center of the nation, and occupies the valleys of Steamboat, Wa-sho, Eagle, and Carson. Pas-sonke's band lives and claims Little Valley and the valleys on the headwaters of the Rio Clara. The Washos are not inclined to agricultural pursuits, nor any other advancement toward civilization. They are destitute of all necessaries to make life even desirable. There is not one horse, pony, or mule in the nation. They are peaceable, but indolent. In the summer these houseless wanderers stay around the shores of Lake Bigler, in the Sierra Nevada. In the winter they lie about in the *artemisia* (wild sage) of their different localities, subsisting on a little grass-seed." *

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* The telegraph has since been carried (as has been before remarked in Introduction) eastwardly beyond this point on my route as far as Fort Churchill, at the bend of Carson River, and it is the intention to continue it all the way to Great Salt Lake City, and, indeed, to the Platte River, which has already been reached at Fort Kearney from the east.

The vocabularies of these tribes of Indians, for which I am also indebted to the major, will be found in Appendix P.

Besides Major Dodge, other gentlemen of the place have called on us, all of whom express themselves very much gratified at the success of our expedition, and tender us all the hospitality in their power. Major Dodge is going to-morrow to Placerville, with one of the head-chiefs of the Pi-Utes, Won-a-muc-a the younger, and two braves, and has extended to me an invitation to accompany him. It is necessary for me to go to San Francisco, on account of the party, and I therefore have gladly accepted the invitation, and will take advantage of the facilities which he offers.

Now that we have reached the termination of explorations westward, it may be well to briefly state the fruits of it. For the first 64 miles west from Camp Floyd, as far as Short Cut Pass, the route we have come was that I explored and established in October, 1858; thence to Hasting's Pass, 70 miles, it was Chorpenning, the California mail-contractor's extension of my route, made by him subsequently to my exploration in the winter of 1858–'59. To Hasting's Pass, Chorpenning's extension was pretty direct toward Genoa, but from that point, on account of his agent, Mr. Egan, failing, as I was informed, to get through in a southwest direction to Carson Lake, he was forced to take a northwardly course, and join the Humboldt route at Gravelly Ford, thus making a great detour in that direction. Finding Chorpenning's continuation of my route of last fall wrong from Hasting's Pass, I struck southwestwardly from that point for the north bend of Walker's River, and was rewarded in getting a route which most favorably compares with the old route from Camp Floyd (via City of Rocks and Humboldt River, and with Chorpenning's route), as follows:

From Great Salt Lake City to Genoa, by City of Rocks, Humboldt River, and Carson River, as given me by my guide, Mr. Reese, who has been several times over the route, and says it was measured by some foreigner	813 miles.
Great Salt Lake City to Camp Floyd	40 "
Total from Camp Floyd to Genoa by old Humboldt River road	853 "
Camp Floyd to Genoa by Chorpenning's route, via Hasting's Pass and Humboldt River and Carson River, 64 + 170 + 455	689 "
Camp Floyd to Genoa, by my route	565 "

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* For other information in relation to the Indians of Utah Territory than is contained in my Journal and Introduction, see Appendix O.

Difference in favor of my route over the old City of Rocks and Humboldt River route	288 miles.
Difference in favor of my route over Chorpenning's, or the present mail route	124 "

Thus we have got a route over which we have conducted our 14 wagons without any great difficulty, and which, except at the extreme ends (over Great Salt Lake Desert and over the desert just to the east of Carson Lake), furnishes an abundance of scrub cedar on the mountain-ranges, which will require a maximum haul of only about 10 miles, to supply the telegraphic lines with the necessary poles (if they will answer by splicing) for the support of the wire. Over the deserts referred to the maximum haul would be, on the Salt Lake Desert, about 50 miles; on the Carson Lake Desert, about 25 miles. The route, also, is quite well supplied with the best of grass and water, except over the deserts mentioned. (The sequel will show that I shortened the route still further on my return to Camp Floyd; and, also, on my more southern route, reduced the haul of cedars for telegraphic purposes over the Salt Lake Desert to 15 or 20 miles*).

June 13, *Camp No.* 38, *Genoa.*—Longitude, 119° 40′ 30″; latitude, 38° 59′ 33″; magnetic variation, 16° 40′ E.; elevation above the sea, 4,824 feet; thermometer at 6 a. m., 54°.50. After giving directions to Lieutenants Smith and Putman to keep up the astronomical observations, and Lieutenant Putnam to make an examination of the old road as well as the Daggett trail over the first range of the Sierra Nevada into Lake Valley, leave the party in the charge of Lieutenant Murry, and start for San Francisco, 260 miles distant, via Placerville and Sacramento, at 8 a. m., with Major Dodge. Expect to be absent about 12 days, during which our animals and party will be able to recruit. Besides the three Pi-Utes mentioned yesterday, the Major has with him his interpreter, Dick, a lad about 15 years of age, and as bright a boy as I have seen for a long while. The major takes a great deal of interest in him, and looks after his welfare as if he were his own son. We all go mounted and take one pack-mule, the mule I ride, as well as a share of the pack-mule, having been kindly tendered to me by the major.

Our course lay for a short distance up Carson Valley, or southwardly on old road. In 1.5 miles from Genoa, pass Warm Springs, at foot of Sierra Nevada; 1.5 miles farther brought us to the Daggett trail, which we take over the east range of the Sierra Nevada to Lake Valley; the traveled wagon-road which we have left continu-

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* The distance from Great Salt Lake City to Genoa on old Humboldt River route, as given above, may be incorrect, and I suspect it is so; but, in the absence of anything official at the time, I could find nothing more reliable. Since my return to Washington, I find that Captain Marcy, in his "Prairie Traveler," lays down the distance from Salt Lake City to Reese's ranch (now Genoa) by this route as 774 miles. The case will then stand thus, regarding the cuts-off I made on my return to Camp Floyd:

From Salt Lake City to Genoa, according to Marcy	774 miles.
From Camp Floyd to Salt Lake City (Simpson)	40 "
From Camp Floyd to Genoa by old Humboldt River road, then	814 "
From Camp Floyd to Genoa, by my more northern route and "cuts-off"	531 "
Difference in favor of my shortest route over old Humboldt route from Camp Floyd	283 "
Difference in favor of my shortest route from Salt Lake City	203 "
Difference in favor of my route over Chorpenning's	158 "

ing along the foot of the Sierra Nevada, on its east side, from 18 to 20 miles, before turning to the west to cross the range. Find the trail up to Daggett Pass quite steep. It runs along the side-hill, and at times is dangerous. It is possible, however, that a better grade might be got along the ravine for a road. In about 3.5 miles from foot of the Sierra reach summit of pass, 7,180 feet above the sea, and lying about 4 miles to the northwest of us could be seen Lake Bigler, beautifully embosomed in the Sierra.* Descending by a tolerable grade, 2.5 miles farther brought us to Lake Valley, lying between the east and west ranges of the Sierra, which we thread in the direction of its length about 12.5 miles southwardly to mail-station, which we reach at half-past 1, and where we dine. Distance from Genoa, 21.5 miles.

The ride this morning the most charming I have had for a long while. Lake Valley is like a beautiful park, studded with large, stately pines. The glades between the trees are beautifully green, and the whole is enlivened by a pure, babbling mountain-stream, the most southern and principal branch of the Truckee, coursing along northwardly to its expansion, Lake Bigler. The pines of various kinds are very large, and attain a height of probably from 100 to 150 feet. Their diameter is not unfrequently as much as 8 feet, and they sometimes attain the dimension of 10 feet. Just before we reached the mail-station, noticed a splendid waterfall or cascade, a tributary of the Truckee, tumbling into the valley from the west range. Saw in the valley a large herd of cattle and hogs, all looking finely. Indeed, I never have seen more sleek, saucy-looking cattle anywhere.

At the mail-station met Mr. T. A. Thompson, the celebrated Norwegian, who carried the mail across the Sierra Nevada, on snow-shoes, from about the middle of last April to fore part of May. He represents the snow to have been, in places where he had to go, 10 feet deep. One of the hands at the mail-station told me that in the spring the snow at one time was as high as the top of the window (pointing to it), that is about 8 feet. This between the two ranges in Lake Valley. Thompson says that the first wagon went over the road across the mountains about 20th of May, the snow preventing it before.

After dinner proceeded on journey. Just after leaving mail-station, commence ascending, by a side cut, the west range of the Sierra Nevada, and directly under the spray of the falling cataract mentioned before, which comes down from a height of several hundred feet, and rushes directly over the road. In about 2 miles from foot, attain summit of range, or Johnston's Pass (altitude above the sea, 7,222 feet). Grade of road good until near top, where it is rather steep. This grade is the commencement of a road which the people of El Dorado and Sacramento Counties, of California, at the expense of some $50,000, have made from Lake Valley across the west range of the Sierra Nevada; and quite well has the work been laid out and executed. I am told the superintending engineer was Mr. Sherman Day, of San José, Cal., who bears the reputation of being quite accomplished in his profession.

As soon as we attained the summit of the range, Mr. Thompson took us to a point where we obtained a fine view of Lake Bigler. After reaching summit, soon find yourself passing along the north side of the South Fork of the American River, and a more roaring, rushing, cataract mountain-stream I never beheld. Indeed, the views along this stream, and at the Slippery Ford, are superbly magnificent. The mountains at Slippery Ford, 6 miles from Johnston's Pass, are a mass of granite from bottom to top. Major Dodge and myself would ever and anon stop to contemplate and discourse upon the beauty of the prospect. Indeed, my ride to-day can never be effaced from my mind.

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* Frémont, in his report of 1845 and 1846, calls this sheet of water *Mountain Lake;* on his map of 1848 he calls it *Lake Bonpland.* It now is known by the name of *Lake Bigler*, and according to the report of Mr. George H. Goddard, of California, "it is a noble sheet of water, from 15 to 20 miles in length by 6 or 7 in width."

Mr. Thompson showed me stumps, or broken-off trees, that he looked down upon last winter and spring when he carried the mail across the mountains on snow-shoes. This corroborates his statement that the depth was as much as 10 feet. He said he found a man in Lake Valley, last winter, that for 12 days had remained at one spot, not able to move on account of his feet having become frozen. All this time he lived on a little flour.

At half-past 5 reach Barry's, where we stop for the night; by the way we have come (Daggett's trail) 33 miles from Genoa. Judge Child, of Genoa, and Mr. Thompson, also put up here. The soil, after crossing first range of the Sierra, is generally of a reddish hue, and is a sort of arenaceous loam. The valley of the South Fork of the American below Slippery Ford is called Strawberry Valley, on account of its being prolific of this fruit.

Mr. Thompson showed me how he walked on his snow-shoes last winter. They are smooth pieces of board from 6 to 8 feet long, 6 inches broad at forepart, 4 at middle, and less at ends, the forepart slightly turned up like a sleigh-runner. A little in front of the middle portion a strap or thong is nailed across, in which he slips his toes, then there is a cleat nailed across, against which the heel of his shoe strikes or pushes. He then gently lifts the shoe, and at the same time pushing it along with his foot, causes himself to slide first with one shoe and then with the other. He has at the same time a stick against which, as he goes down hill, he supports himself, and which he uses also as a break. He says he has a standing bet with any one that, let him select his ground along a side-hill, he will travel a mile a minute; that he sometimes passes over precipices of 10 feet, and would land at a distance of 20 feet, and still stand upright. When a child in Norway he used, with other boys, to practice this kind of leap, and thus made himself an expert.

I notice that the telegraph-line along the road over the mountains is, in many instances, supported by living trees as posts. Also noticed a number of coils of wire lying along the road, which are intended to be used in extending it from Genoa toward Camp Floyd and Great Salt Lake City.

June 14, *Barry's, on South Fork of American River, Sierra Nevada.*—Bunks erected for travelers at this stopping-place, and blankets and comforters for bed-clothes. The luxury of sheets not yet gone into. House of split clapboards, and quite rude, but yet a fair mountain-house in a new country, and table quite good.

Renewed journey at 10 minutes before 6. Met a four-horse comfortable-looking stage going over to Genoa, to run between that place and the new gold-mines on the Rio Ida, the East Fork of Walker's River, 90 miles from Genoa. These placers were discovered in the fall of 1858, and are pronounced very rich. The gold is said to be worth $18 per ounce, it being mostly shot-gold, and not in the dust. Two miles from Barry's a side cut of excellent grade commences, which continues for 25 miles, and is a piece of road which would do credit to any of our older States. Its defects are in not being sufficiently wide for teams of more than two draught animals to turn (except with the greatest care) its sometimes sharp angles, and in places it does not admit of teams passing each other. These defects should be rectified. Ten miles from Barry's reach Boswell's, a very good log-house, and place of refreshment and lodging. Seventeen miles more, at 11½ o'clock, reach Peter Burdie's, where we dine and feed animals.

Leave at 25 minutes of 2. One and a half miles from Burdie's, cross South Fork of American River to south side by bridge, and do not see it again till we reach Sacramento. To this point (the bridge) we have been traveling from summit of Johnston's Pass along north side of this river, which at times we could see as much as 1,000 feet below us, and always raging, rushing, and making a din, out of which we have not been since we got on it. As yesterday, until about 5 miles back, the granite has shown itself in magnificent proportions.

As soon as we cross the American Fork we emerged from the mountainous region, and the country became more open and rolling. Farms, farm-houses, and improvements generally, increase as you approach Placerville, and the fences, fruit-trees (principally peach), wheat, potatoes, gardens, domestic pigeons, reddish Maryland color of the soil, and large umbrageous oaks, which become more frequent, intermingling with the pines, make you almost think you are east of the Rocky Mountains in an old settled country. Indeed, until my present exploration, I have had no proper idea either of the Sierra Nevada or of the country at its western base. The transit from the arid plains east of the Sierra Nevada to the quick teeming country lying on its western slope is most singularly marked and sudden, and shows how much, irrespective of latitude, the laws of climate and production are dependent upon physical circumstances and features of country.

Pass a tavern called Sportsman Hall, 6.5 miles from bridge over South Fork of American, and 12 miles more brought us, about sundown, to Placerville, a mining-town on a small tributary of the South Fork of the American, 79.5 miles by Daggett's trail from Genoa. This town is built principally upon one street, and is divided into what is called upper and lower town. The latter is the business portion, and has a great number of stores; some pretty white cottages, with roses clambering up the porticoes, and gardens filled with vegetables and fruit-trees, being visible. Pits seen everywhere, where they have been digging for gold, and the little stream coursing through the town is red with the sediment, which has been the result of gold-washings. The streets, I notice, are filled with people, and the hotels are full, caused by the assemblage of a convention for the nomination of county officers. Thanks, however, to the kindness and forethought of friends, a room has been reserved for Major Dodge and myself at the Carey House. Population of town about 3,500, and of township, 10,000. Was called on by several influential men of the place, who congratulated us upon the success of our expedition in getting across the Great Basin and shortening the central overland mail-route so much. Col. Fred. A. Bee, the president of the central overland, called the Placerville and Saint Joseph Telegraph Company, was particularly gratified, and remarked to me that I might consider my route as adopted for the line. I told him to wait till I could report from Camp Floyd the results of our exploration for a shorter return-route before he decided, for I believed I could get a still better one, which would be from 30 to 50 miles shorter.

June 15, *Placerville.*—Remain here to-day to perfect arrangements about sending a few supplies over the Sierra Nevada to party at Genoa. Require some extra wagon-tongues and couplings, and think it well to provide ourselves with a little forage and a few other things to meet contingencies.

Visited steam-crushing quartz-mill in the city for the extraction of the gold. It has 20 vertical iron tamps, about 2 inches in diameter, placed in upright frames, and so fixed with projecting shoulders that a horizontal shaft, turning on its axis and provided also with projections, lifts the tamps, and their own weight is such that they fall heavily and tamp or crush the quartz, which is placed in a box at their feet. A stream of water is constantly passing through the box, and carries the *débris* and gold over an inclined apron, on which are arranged, horizontally, slats or riffles, which catch the gold as it passes. The quartz is conveyed to the mill from the mine, near, in cars, which run on a railway from a shaft or tunnel which at the present time has penetrated the bluff horizontally about 200 yards, and is about 40 yards below the superior surface of the ground. I entered the shaft and saw the miners at work getting out the masses of quartz. It is singular that in any of the quartz I saw I could not, with the eye, detect the slightest speck of gold; and yet I am told the investment in the business is a good one.

Visited, with Major Dodge, Colonel Bee and lady, and were regaled with fresh strawberries from their garden, and brandied peaches, which were the first foretaste I had had of the fine rich fruits for which this region is famous. The colonel has a pretty cottage residence, tastefully adorned with flowers and fruit-trees, and conspicuous in his garden is a windmill, by which the water is raised from a well and so conducted by small canals as to irrigate the soil. The windmill, I notice, is quite a common feature in the landscape of this country, and has become so on account of the necessity of irrigating the soil to make it productive, to which purpose it is applied.

Ordered a bill of supplies to be transported to Genoa, at 7 cents per pound. The usual charge, I am told, is about 5 cents, but in order to insure their being carried over immediately, I am obliged to pay 7 cents. One cent per pound is to be forfeited if not delivered by the 22d instant. The cause of this heavy charge for transportation is the steep, rocky character of the portion of the road over the east range of the Sierra Nevada, between Lake Valley and Carson Valley, which I shall examine on my return to Genoa, and on which the Californians have expended no labor, for the reason, doubtless, that it lies mostly, if not entirely, in Utah.

June 16, *Placerville.*—Left with Major Dodge for Folsom, 28 miles distant, at 6 a. m., Pi-Ute interpreter Dick in company. Conveyance the finest kind of stages, and drawn by large, strong, well set up, stylish horses. Fare to Sacramento, $6. Breakfast at Duroc's. At Folsom took railroad-cars for Sacramento, the capital of the State, 23 miles distant, which we reached about 1. Country between Placerville and Folsom beautifully rolling; between Folsom and Sacramento, very level. It is generally

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cultivated, and beautifully rich with grain, which is being harvested, and the neat board fences and houses everywhere attest the rapid growth of the State and the enterprising character of the people. The pine is seldom seen after you leave Placerville, and from Folsom west the oak is almost entirely the native tree. They are very large and umbrageous, and being interspersed in a park-like way, give a beautiful aspect to the landscape. The ugly stumps of the recently-cleared lands in our older States are nowhere to be seen.

At Sacramento there were nine steamers, great and small, lying at the wharves. The Eclipse, in which we took passage at 2 o'clock for San Francisco, is like our Mississippi boats, and as handsome, comfortable, and neat as the best of them. Fare to San Francisco, $5, and $1 additional for dinner. Distance, 120 miles. Had but little time to glance at the city, but saw enough to convince me of its business thrift. Hope to see more of it on my return. Saw Mr. Upson, editor of the Union, who expressed himself as delighted with the success of our expedition across the Great Basin.

The Sacramento is a noble stream, probably about 200 yards wide. Its color quite red, like all the streams I have seen this side of the foot of the Sierra Nevada, caused, I am informed, by the universal use of the water for washing gold out of the soil, which is of a red color. At the present time the river is from 4 to 6 feet below the top of its banks, and at times is said to overflow them. Indeed, in order to protect the city of Sacramento from inundation, a levee has been made all around it. The country between Sacramento and the bay of San Francisco lies very low and level, as far as the eye can reach, and everywhere looks rich and productive. Windmills for purposes of irrigation are a prominent characteristic. As you approach San Francisco the land assumes a higher and bolder aspect, and the mainland, as well as the islands, become remarkable on account of their peculiarly bold and convex shape from the water up; and the brownish-red colored oats, at this season of the year, occasionally relieved by dark patches of timber, give a very unique character to the landscape. Touched at Benicia, where there is a military post, and had a chat with Maj. George P. Andrews and Lieut. Job J. Chandler, Second Artillery, who, seeing me in military attire, introduced themselves. Reached San Francisco at a quarter after 9 in the evening, and put up at the International Hotel.

June 18, *San Francisco.*—Intending to leave to-morrow on my return to Genoa, have only time to see friends. Find, however, the place exceedingly city-like. Has many fine, substantial houses. The streets, especially Montgomery street, are full of people. Everything seems to be done on the high-pressure principle. Rents, I am informed, are still very high. Visited the market and saw a splendid exhibition of vegetables. They have the largest strawberries here I have ever seen. Notice the egg of a wild water-fowl, which is found on the islands and exposed for sale. Called on a number of old friends, principally officers of the Army. Was invited to take a ride about the city and suburbs, but had not the time. The cool breeze from the Pacific, generally in the afternoon, makes winter-clothing agreeable even in the depth of summer. Messrs. McCrellish & Woodward, of the Alta-California, are anxious that I should allow Mr. Walter Lowry, their city commercial correspondent, and who is an

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invalid, to accompany us on our return to the States. He is desirous to see his friends and relatives once more in that quarter, and thinks that a trip across the plains will restore him to health. In consequence of the rough character of the country, I have demurred until I could see him personally at Placerville.

June 19, *San Francisco.*—Having transacted all my business, at 4 p. m. Major Dodge and myself took passage on board the steamer for Sacramento, on our return to Genoa, $7.50 fare for passage and half of state-room. I leave with a great deal of regret, feeling that my visit has been so short as scarcely to have permitted me to see anything; but duty requires me to join my party without delay. The harbor of San Francisco, which we now see by daylight, is doubtless one of the boldest in the world. The grand characteristics are its commodiousness, and, as I have before stated, bold, convex character of its islets and headlands, and the peculiar brown or russet color of the face of the country, caused by the all-prevailing wild oats in their present ripe condition.

June 19, *Sacramento.*—Reached this city in the night. Put up at Saint George Hotel, General C. J. Hutchinson proprietor and landlord. In the morning Major Dodge and myself went to Episcopal church with Mrs. Hutchinson and another lady, the general having politely extended to us seats in his carriage. The whole style of the services and the sermon, as well as of the church, carried me back to the happy occasion, when, with my own family and friends, I had, more than a year previous, been enabled to join them in these sacred duties.

Among the gentlemen who have called upon me and showed us a great deal of attention is Mr. James R. Hardenburgh, an old schoolmate and fellow-townsman of mine, from New Brunswick, N. J. We had not met for 28 years, and, of course, the pleasure was correspondingly enhanced. I must also acknowledge the kind tender of services of Mr. M. S. Brocklebank, the brother-in-law of Governor Weller, who made himself known to me, and treated me very civilly. The city is full of strangers, drawn here by the State convention, which is about to meet, to nominate candidates for State offices. Among the distinguished is Governor Denver, whom I last saw at Fort Leavenworth, just before I left for Utah, in the spring of 1858. This city is very well built, considering its age; has a number of fine dwellings, and the country around it is remarkably rich and productive.

June 20, *Sacramento.*—Took cars for Folsom at 7, and arrived at Placerville at 2. Settled with Mr. Richardson for supplies, which have been forwarded to Genoa according to agreement. Was introduced by Colonel Bee to Mr. Walter Lowry, the correspondent of the Alta-California, the gentleman Mr. McCrellish, of San Francisco, spoke to me about. Saw at once his feeble state of health would not permit him to endure a journey across the continent, and tried to dissuade him from accompanying us. He will, however, not heed my advice; and my hope is that, if he finds the journey across the Sierra Nevada too fatiguing, he will yet give up the idea of continuing on with us from Genoa.

June 21, *Placerville.*—Left at 9½ o'clock, with Major Dodge, Mr. Walter Lowry, and Mr. Van Duyck, for Genoa, retracing as far as Lake Valley our old route. Our conveyance is an ambulance, which the major has had made at this place. Our driver is the famous Norwegian, Thompson, of whom I have before spoken; Pi-Ute Dick is also along. Stopped for the night at Peter Burdie's, 20 miles from Placerville.

June 22, *Peter Burdie's, Sierra Nevada.*—Left at 5 a. m., and reached Yankee's, or mail-station, in Lake Valley, 40 miles from Burdie's, and staid all night. I notice that, after leaving the 25-mile side-hill grade, before spoken of, and before reaching Johnston's Pass, the road is very rocky, and in many places steep, and, like the portions mentioned under date of June 14, should be improved.

June 23, *mail-station, Lake Valley, Sierra Nevada.*—Elevation above the sea, 6,311 feet. In order to get over to Genoa as early as possible, left Major Dodge at station, and took passage in the mail-stage, leaving at 3 a. m. Passengers, a lady and child and two men, with myself. Driver a famous whip, but who, unfortunately, had all night long been carousing with some others at the station, and was quite drunk when he started. He seemed, however, to be sober enough to ask me to sit with him outside, and, as I thought, that I might take the lines if there should be occasion. Had scarcely left, before, on account of the darkness of the night, the mules got out of the road, and came near breaking the stage by passing between two stumps. Being on the box, I was enabled to draw up the team in time, not, however, without the loss of a whipple-tree. The next obstacle was the bridge, from the farther half of which the puncheon flooring had been removed by some mischievous persons during the night, and piled up on the bank.* I got off, and, with the assistance of one of the passengers, who was, like the driver, a little boosy, replaced the flooring, a space of about 2 feet being left on the farther side, on account of a deficiency of material. Nothing daunted, however, the driver rushed over, and fortunately gained the opposite bank without accident. After this, in ascending the acclivity from Lake Valley to summit of Luther's Pass, 5 miles from mail-station, had a very serious time. All hands out to enable him to get up the hill. Driver so drunk as not to know what to do, and yet as obstinate as a mule; slashes the animals all around, but yet in such a way as not to make them work together; the consequence is a dead halt. Was glad of it, for the reason that if he could have got to the summit before he became sober he would have dashed us all to pieces in his descent on the other side. At last, just before reaching summit, the stage upset and broke the tongue. Luckily, at my suggestion, all were out at the time. Here was a dilemma. I helped to get the stage out of the road. The driver then took his mules and went down to the next house on the road, for a wagon. About an hour after, Major Dodge appeared with his ambulance, and kindly took the lady and myself in with him, and left Mr. Van Duyck and Dick to follow in the stage. In about 4 miles, met driver returning with a wagon, a good deal sobered and subdued. At about 9 o'clock reach Woodford's, at the mouth of Carson River Cañon, where we stopped and got breakfast.

The road from Lake Valley to mouth of Carson Cañon, where the fork debouches from the mountains into the valley of Carson River, a distance of 12 or 13 miles, *is the worst portion of the whole road over the Sierra Nevada.* The ascent from Lake Valley to summit of Luther's Pass is very steep, and the road is filled with tremendous rocks, which should have been removed. It is astonishing, considering this is a portion of the great emigration route over the continent, that Congress has not done something toward ameliorating it. There is no portion of my route from Camp Floyd, though the greater portion of it is entirely new, so bad as this. If a road can at all be got over the Daggett trail, which is probable, it ought, by all means, to be done, both on the score of distance and quality of road. At least $30,000 should be appropriated for the portion between Carson Valley and Johnston's Pass, and $10,000 for the portion to the west of said pass. Several bridges to be built across fork of Carson River in cañon. Reached Genoa at 4 p. m. Road from mouth of Carson Cañon good. Distance, 19 miles. Total journey from mail-station in Lake Valley, 31 miles. Lieutenant Murry reports that matters have been going on well during my absence. The good citizens paid my party the compliment of a public ball last evening, which, they informed me, passed off much to the satisfaction of every one. In consequence of Major Dodge and myself having been delayed on the route longer than we had anticipated, we were deprived of the privilege of being present. Paid off several of the party and settled outstanding accounts.

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* The breaking of the whipple-tree I consider providential and a blessing, since without its occurrence we would all have been upset in the creek, and our lives lost or bones broken. The carousing at the mail-station and the taking up of half the bridge was, as I think, all done by the parties who instigated it to rob the mail, Indian agent, and myself, who, it was doubtless well known, had gold on account of the expedition.

RETURN TO CAMP FLOYD.

June 24, *Genoa, Camp No.* 1.—Thermometer at 4.50 a. m., 65°. Concluded settlement of accounts, and at 7 a. m. we took up our march on our return to Camp Floyd. Mr. Lowry will not listen to any advice in opposition to his accompanying us, and I, therefore, think it my duty to acquiesce, though I feel morally certain that he cannot survive the trip. Mr. Reese, though a citizen of Genoa, returns with us as guide, and I have sent him, Ute Pete, and two other persons in advance, to provide for improvement of route, by taking a short cut from bend of Carson to south side of Carson Lake, and to explore for passage through the mountain-range to the east of the sink of Carson. Having been politely invited to dine at Mr. Dorsey's, who lives 7 miles from Genoa, on our road, Lieutenant Murry, Mr. Lowry, Mr. Smith, of Genoa, Mr. Lee, and myself stopped for a few hours, and were kindly entertained by him and his lady. Mr. and Mrs. Noteware, kind neighbors of the family, were present. Train reached Carson City early in the afternoon, and party encamped. We reached it about dark. Journey, 13.8 miles. Route the same as traveled on outward journey. In the evening were visited by Major Ormsby and lady, and other persons, who take a kind interest in the success of our expedition.

June 25, *Camp No.* 2, *Carson City.*—Had the first cool night I have experienced for some time. Consequence, a refreshing sleep. Moved at 5 a. m. In 11.7 miles reach Chinatown, about 9.30 a. m. Altitude above the sea, 4,360 feet. Here leave our old road, and immediately cross Carson River by ford, and take route along river on south side. Depth of water, 3.5 feet. Wagons barely escaped receiving water in them. One forage-wagon capsized. All the rest got over without difficulty. By 11 all across. Five miles from ford, after crossing some bad sloughs, which may be obviated by taking higher ground, reach camping-place for the night. Journey, 17.2 miles.

June 26, *Camp No.* 3, *Carson Valley.*—Elevation above the sea, 4,300; thermometer at 5 a. m., 49°. Mosquitoes during the night terrible. Moved at 5 a. m. Continued along an old road on south side of Carson River for 2 miles, where we join, opposite Pleasant Grove, our old outward track, and continued on same 12.6 miles to east foot of ugly hill referred to June 9, which we found we could not, as we hoped, evade by passing between it and the river. Going east, however, the hill is not bad. The difficulty, as before stated, is in the ascent from the east side. After attaining valley on east side of hill, we left our outward track and old road, and turned to the left down the valley to within a few hundred yards of Carson River, and then go over another spur, and in about a mile get into valley of Carson River again, which we follow down 2 miles, and at 1.15 o'clock encamp on the river bank. Journey, 18.2 miles. Our experience shows that the road from Pleasant Grove on north side of river better to Chinatown than that on south side. It is a characteristic of this valley that the miry, rich soil prevents your approaching the stream except at a few points, and these are the best camp grounds. Cottonwoods and willows line the banks. The mules fattened up wonderfully at Genoa, and they are now in prime condition. One of the guide's party came into camp this afternoon, to show us our route to-morrow.

June 27, *Camp No.* 4, *Carson River.*—Elevation above the sea, 4,154 feet; thermometer at 4.30 a. m., 52½°. Resumed march at 5. Continued down valley of Carson River eastwardly about 2 miles, when we leave it and strike for south end of Carson Lake. Low mountains, perfectly destitute of timber, and of a brownish-reddish hue, range on either side and parallel to the river. Eight miles farther commence ascending a sandy ravine of slight grade, and in 3 miles attain summit of a low range 4,460 feet above the sea, from which, looking back, Carson River can be seen, well marked by the trees which line its banks. At intervals of 2.5 and 1.7 miles cross other low ridges, the last tolerably steep on east side; and 7½ miles farther, at half past 5, reach south end of Carson Lake, where we encamp. Journey, 25.1 miles. Road first 10 miles good, next 12 miles sandy and heavy, last 3 miles over margin of lake and good. Fine grass and rushes where we are encamped. Fuel should be brought.

June 28, *Camp No.* 5, *south end of Carson Lake.*—Elevation above the sea, 3,840 feet; night refreshingly cool; thermometer at 4.58 a. m., 55°. Moved at 5 minutes after 5. Continue along shore of Carson Lake, at foot of point of low range or spur, being sometimes, on account of marsh, forced on first bench; and, after crossing an alkali flat, 7.5 miles from last camp, join our outward route, which we follow along the lake shore 4.5 miles farther and encamp. Journey, 12.2 miles. Road good. It was my intention to proceed farther along the lake, but Wilson Lambert, of the guide's party, meeting us here, and informing me that Mr. Reese had not, as was hoped, been able to find a practicable route for wagons through the mountain-range immediately to the east of the sink or more northern lake of Carson River, I am obliged to give up the idea of shortening my route in that direction, and to strike eastwardly and cut off the angle or cusp, caused on my outward route by the mistake of my guide, mentioned in my journal of June 5. There is an Indian trail, it appears, east from the sink of Carson, which is practicable for pack animals, but it would require considerable work to make it so for wagons. The next camp-ground, according to guide, is 7 to 9 miles from here, and is represented as being alkaline, and the supply of water a small spring. The guide, it seems, supposed we could not reach this spring till to-morrow, and intended sending back a man, the day after, to report the camp beyond. The result is that as our animals will fare best where we are, I have ordered a halt, and the command, as stated, to go into encampment.

I have noticed the pelican to-day floating on the lake and looming so large as to look like a small sail-boat. Our old road along the lake is at present overflowed by the water of the lake, and this when Carson River, which feeds it, has declined several feet. This shows that the lake does not sink and evaporate as fast as the water flows in. The best grass is to the north of our camp, to which we have driven our herd. Fuel should be brought.

June 29, *Camp No.* 6, *east side of Carson Lake.*—Elevation above the sea, 3,840 feet; thermometer at 6 a. m., 70°. In consequence of laying over at this camp for the benefit of the water and feed, and not wishing to tarry any longer than necessary at our next, where the water and grass are said to be very scant, and the latter alkaline, we did not move till 2 o'clock. At 11 o'clock a Mr. Ward, of Placerville, and three other persons, joined us, in order to accompany us on our route and thus have the benefit of our protection.

The nearest direction for the road would be from south end of Carson Lake directly across eastwardly to Alkaline Valley, but though there is a low pass to admit of a pack-route, Mr. Reese has reported it too full of sand to allow the passage of wagons.

We cross a low rocky ridge, 1 mile to the east of camp, and gradually bear to the right, and pass east of south along west edge of Alkaline Valley. Five and a half miles from camp come to grassy bottom, where there is some tolerable grass, and water probably within a foot of the surface. To the west of this place in the flat is a very small warm spring of pretty good water. The efflorescence around it is not alkali, but pure salt. This being the case, the probabilities are that by digging wells in the vicinity where there are indications of water, good water might be obtained. Two and a half miles farther brought us to a spring 6 feet long, 2 deep, and 1½ wide, which is sulphurous, but not unpalatable. There is a small patch of rushes in the vicinity, but no grass. This was the locality intended by our guide as our camping-ground for the night, but the water and grass proving insufficient we only water the animals scantily and then push on, believing it better to get to the best grass and water as soon as possible, though in order to do so we shall have to travel all night.

Leave spring at 17 minutes after 5, and in 7.5 miles after crossing Alkaline Valley, join our outward route, near point of mountain, not far from our old camp, No. 30. Here we halt to take some coffee and feed the draught mules with some of the forage we have brought with us. The Alkaline Valley where we crossed it will evidently be impassable from mire in wet weather. In this case, persons coming from Carson Lake, should cross the valley about 7 miles north of dug-holes, and then cross on tolerably hard and high ground.

Leave at half past 11 p. m. Night pleasantly cool. Just before daylight felt oppressively sleepy, and every once in a while, though riding in the saddle, would catch myself dozing. One of my assistants passed me at daybreak, at a gallop, as I thought to quickly arrive at our next camping-ground, but I had not continued far before I found him stretched out on the ground, fast asleep, holding his mule. Proceeding on in advance of train, I arrived at old camp (No. 29), Middle Gate, 23.4 miles from halting place of last evening, at 7 a. m. June 30; but unfortunately found the water, which was running before, was now to be got only by digging, and that scantily. The train did not get in till 10. We shall turn out our mules to graze and let them drink what water they can in the dug wells. Meantime, get breakfast. Found Pete at this point, and Mr. Reese came in subsequently on his return from a reconnaissance still farther ahead.

It should be remarked that there is not the slightest doubt that water in abundance could be got at this point (Middle Gate) by sinking suitable wells. Indeed, it exists now in springs in an *arroyo* near, and we got it in another easily accessible place by digging not more than two feet deep. There is plenty of rock at hand to wall the wells. I think it very probable, also, that in "West Gate," 3.5 miles west of this, water may be obtained by digging. Indeed, the indications are decided, also, that in the moist places in the Alkaline Valley we passed over yesterday afternoon, where there is no alkaline efflorescence, water could be got in sufficient quantity, and that it possibly would be good. I have already noted that while portions of the desert are alkaline, some portions discover pure salt on the surface, and others none of any kind. There are several families of Pi-Utes at this Middle Gate, collecting grass-seed, which they separate from the husks by first rubbing the heads lightly under stones and then winnow, by throwing it up in the wind. Afterward they convert it into a flour by rubbing it by the hand between stones. I notice they use a variety of seeds in making flour These Indians have come from Carson Lake, and appear to be industrious and able-bodied. I doubt not their present life is such as to make them facile subjects of husbandry and civilization generally. Indeed, I have been assured that some of them do hire themselves out as laborers in California for considerable periods of time—as long as a year at a time—and that they have been found faithful and to work well.

Resumed march at half past 1. In 1.75 miles cross an *arroyo* where the water yesterday, according to Mr. Reese, was running, but now exists in small pools. A small spring about two feet deep and one wide has been found to the right of this point, about three-quarters of a mile. There is no grass about it. Water not unpalatably sulphurous, but too scant for anything of a party. After crossing an *arroyo*, or creek, immediately leave old road, and bearing off to the left or northwardly, pass up valley, bounded by the Se-day-e Mountains on our right and a range of high mountains on our left. Distance between crests probably fifteen to twenty miles. Trees for first time since leaving Carson Valley appear on the Se-day-e Mountains, and also on the range to our left toward its north portion Grass and water are visible in the ravines of the Se-day-e Mountains.

Ten miles from Middle Gate reach, near base of Se-day-e Mountain, a small running brook of icy-cold, pure water, which I call Cold Spring, and which, after running a few hundred yards, sinks. A more refreshing drink than I obtained from this brook, after the parched, wearisome travel of last night, I believe I never had. The men all seemed equally eager for the cold draught, and were equally delighted. But we have felt most for the poor animals, which have had but about a pailful apiece since yesterday afternoon. They are so fagged, that they failed to get up with the wagons to the stream, and we are forced, therefore, to go into camp a mile from the water. The animals are driven to the water, and find an abundance of grass at the head of the creek.

Mr. McCarthy reports water in the mountains to our left, or west of us; also says he found the water running at Gibraltar Gate. Journey, since 2 p. m. yesterday, 49.9 miles; road good.

July 1, *Camp No.* 7, *Cold Spring.*—Elevation above the sea, 5,570 feet; thermometer at 6.30 a. m., 72°. All hands had a most refreshing sleep last night, and it is astonishing what a restorative pure cold water is. At 9 a. m. Mr. Thompson, the Norwegian, before spoken of, arrived and brought our mail from Genoa. He left the latter place on the 27th ultimo, and came by the way of Ragtown, on Carson River, crossing over thence to south side of Carson Lake, where he got into our road.

Mr. Reese, Pete, and four other men, including two soldiers, left about 10 o'clock to examine the country for the purpose of connecting our present route with the new proposed route, south of Ruby Valley. This examination will involve an extent of travel ahead of from 130 to 150 miles.

Party and train decamped at 1 p. m., and continue northwardly up valley. After proceeding 11 miles come to rapid stream of pure water, 2 feet wide, $\frac{3}{4}$ deep, flowing from the Se-day-e Range. On this we encamp. Willows fringe it, and grass is to be found higher up in the cañon. I call the stream after one of my assistants, Mr. Edward Jagiello, a Polish gentleman; his surname being difficult of pronunciation, I have preferred his Christian name as the appellation. Road, to-day, stony, on account of being on bench; farther down in the valley it would be smooth.

Opposite our camp, in the range of mountains lying to the west of us, is a deep pass, in which can be plainly seen an extensive bottom of grass, and a creek running down from it into the valley in which we have been traveling. This creek, and the valley into which it flows, I propose calling after Major Frederick Dodge, the Indian agent of the Pi-Utes and Washos, who was so courteous to my party, and myself, at Genoa. The pass referred to, at the head of this creek, Mr. Reese has examined sufficiently to assure me that a good wagon-road can be got through it without a great deal of expense; and, as he pronounces, after examination, the corresponding pass in the next western range, lying nearest and east of the sink, or north lake of Carson, capable of being also made practicable without a very great deal of labor, a wagon-road could be made direct from Dodge Valley through to the North Carson Lake, which would reduce the intervals between water to 15 miles.

He also reports that cedars are to be found on the mountain-ranges at this interval. This, then, would be also the route for the telegraph. The road might keep to the north or south of North Carson Lake, as might be deemed expedient, and the bend of Carson River could be cut off from its crossing near north end of South Carson Lake, to a point higher up, so as to make the interval between grass and water 15 to 25 miles, as might be found best. This route, as I have already noted, the guide says is now perfectly practicable for pack animals and stock, and is a most capital one for feed and water. It will at once, then, be seen that in the improvement of the route, at any future period, the change referred to should by all means be made. The Indians represent that the snow falls in Dodge Valley as much as 2 feet deep, and that in some winters there is scarcely any. They say that generally there is very little snow from Genoa to the Se-day-e Mountains.

July 2, *Camp No.* 8, *Edward Creek, Dodge Valley.*—Longitude, 117° 31′ 42″; latitude, 39° 28′ 56″; altitude above the sea, 5,486 feet; thermometer at 6 a. m., 71°. Private Collamer returned from the guide's party at sunrise, and reports that he rode till 12 midnight, then took 2 hours sleep, and his mule having given out, he came the rest of the way to camp on foot. He therefore is our guide to-day.

Mr. Thompson left us at half past 7 for Genoa, and intends going by the way of North Carson Lake.* We at the same time decamp, our course being southeast up the cañon of Edward Creek, the purpose being to cross the Se-day-e range. After traveling 7 miles, at half past 1, go into camp in superior grass, and on the babbling Edward Creek, three-fourths of a mile short of summit of pass. The road up the cañon is good and of excellent grade. A few patches of snow seen on the highest ridges of the Se-day-e Mountains. The piñon is almost the only *sylva* of the mountains. Willows, aspens, and cottonwood line the creek. It is quite refreshing to men and animals to again toil in the cañons, where nature has been more lavish of the essentials of a good emigrant route, to wit, wood, water, and grass.

July 3, *Camp No.* 9, *Edward Creek Cañon.*—Se-day-e Mountains. Elevation above the sea, 7,022 feet; thermometer at 7 a. m., 76°. Remain in camp to-day, on account of its being Sunday, and the animals require the good mountain-grass which we have here in great abundance. Lieutenants Murry and Putnam and Mr. McCarthy went this morning through the pass at the head of Edward Creek to Woodruff Valley, and report but little work to get through with the wagons.

July 4, *Camp No.* 9, *Edward Creek Cañon.*—Thermometer at 4.45 a. m., 62°.50. Move at 5.15 o'clock. Continue three-fourths of a mile up cañon to summit of pass, 7,260 feet above the sea, and then turning eastwardly, in 1.5 miles, by branch ravine, reach Kirby Smith's Creek, the cañon of which we follow down, 3.25 miles, to where it debouches into Woodruff Valley, and, continuing along creek 3.3 miles farther, encamp on it. About 2 miles from summit of pass is a rock projecting from north side toward the stream, which made it necessary for us to go behind and over the rock on its north side; though by twice bridging the stream, which is 8 feet wide and 1 deep, a road of unexceptionable grade could be made in the bottom of the creek. Trains going east, like ours, could easily take our route, but going west, to do so they would be obliged to double up a steep ascent for about 100 feet. About 2 miles farther down the cañon there was another bad place where the teams had to double to ascend from the bottom of the creek to the top of the bank, and from which they again immediately descended to the creek. A very little labor, however, would be required to carry the road along the bottom at this point.

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* Mr. Thompson, on his return to Carson Valley, at my request, addressed me the following letter on the practicability of a more direct route than mine from Edward Creek to Carson Valley:

"CARSON VALLEY, *July* 28, 1859.

"Captain SIMPSON:

"SIR: I have the honor to report to you my exploration on my return trip from your camp, on the 2d of July.

"I crossed Dodge Valley, and took up a cañon about half-way from Dodge Creek to the low gap on the right. This cañon is well adapted to a wagon-road; it is about 200 yards wide, and bunch-grass stands 2 feet high and very thick. I crossed over this range, but the cañon on the other side is very steep and difficult to go down. Then I came into another valley similar to Dodge Valley, but there is no stream that reaches into the valley. I crossed over this valley, and another high range of mountains, and came to the 'Forty-mile Desert,' on the old Humboldt route, and struck the road 17 miles from Ragtown.

"I did not see any route north of yours that is practicable, and I think yours is the only route in that vicinity that can be made passable.

"Respectfully, yours,

"J. A. THOMPSON."

This letter seems to militate against the report of my guide, Mr. Reese, on this subject, as given above (July 1), but it doubtless is on account of Mr. Thompson having gone to the north of the sink of Carson, and, therefore, much farther north than *he* did.

Road to-day near summit of pass, east side, for 1.5 miles, very rough from rocks which ought to be removed, and requiring improvement at points along creek, as above. Journey, 8.5 miles. On rough portion of road broke tongue of large ambulance, a coupling-pole of one of the wagons, and a wheel of small ambulance.

There is a great deal of grass in Smith's Cañon and the adjoining ravines, and some little clover in the former; but the south pass, or that of our outward route, is still better in respect to pasture. The distance, also, is about 4 miles in favor of the more southern route, but in grade the more northern is much the best. I think it also probable, on account of the bottom of Smith's Creek being moist and, therefore, miry *early in the season*, that until about the middle of June the route through the southern pass would be preferable for wagons; after that, however, the most northern route will be found the best. The truth is, both branches of the route should be made perfectly practicable when the road is perfected, so that either can be taken at any time.

The rocks along the Se-day-e Mountains to Edward Creek and through the pass to Woodruff Valley are porphyritic, of a brown color.

Just after getting into camp, rain began to fall, the first we have had for several weeks. A rainbow also appeared Indians report deepest snow in winter in pass we have come through to be 2.5 feet.

July 5, *Camp No.* 10, *Smith's Creek.*—Woodruff Valley. Elevation above the sea, 6,070 feet; thermometer at 4.45 a. m., 48°. The rain of yesterday, though slight, seems to have purified and refreshed the air. Decamped at 20 minutes after 5. Course north of east, directly toward our old pass between Woodruff and Reese Valleys. In 3.7 miles get into our outward route, and follow it till near Reese's River, where we leave it to the left, and encamp on river, about 2 miles above old Camp No. 25. This river takes its rise about 5 miles above or to the south of our camp, in some pure, cold springs in the valley, and also receives accession from streams from the Pe-er-re-ah Mountains, on the east side of the valley. Saw fine meadows for stock about the springs. Speckled trout weighing from 1½ to 2½ pounds caught in Reese's River. McCarthy brought in a large mess of ducks. Several Pi-Utes followed us yesterday and to-day—two armed with rifles. For further particulars of this valley and to-day's route see report of outward route. Day's travel, 20.8 miles. I would remark that there is an excellent pass from Woodruff to Reese's Valley, to the south of that we used, which would furnish a cut-off from either pass through the Se-day-e range to that of the Pe-er-re-ah range south of the Simpson Pass; which, if the latter is practicable, would cut off the great bend in the road between Woodruff Valley and Won-a-ho-no-pe Valley. There are indications of a pass in this direction in the Pe-er-re-ah range, but we had not time to examine it.

July 6, *Camp No.* 11, *Reese River.*—Elevation above the sea, 5,630 feet; thermometer at 4.40 a. m., 42°. Noticed, going west on our outward route, a great increment of temperature on west side of Se-day-e Mountains, and now since we have crossed to its east side, the thermometer has become correspondingly depressed. Move at 5 a. m. Morning bright as it almost invariably has been. The twittering of the birds, particularly of the meadow-lark, very cheerful. The contrast between the desert to the west of the Se-day-e Mountains, and the valleys and mountains east of it, very marked; the former being of the most forbidding cast, and the latter quite smiling and pleasant.

About a mile below camp cross Reese's River; ford, miry; not near so good as that used on outward route. In 5 miles more join outward route and continue on it through Simpson's Pass and park in the Pe-er-re-ah Mountains to about a mile below the lake, where we encamp in the cañon on Won-a-ho-no-pe Creek. Journey, 16.5 miles. The lake in Simpson's Park we find has fallen considerably since we passed by it before, it at present being only about 2 feet deep, and Won-a-ho-no-pe Creek, which before was a running stream a number of miles above our camp, at this time first gives indications of its existence at the camp. The grass in Reese Valley, through the cañons we have passed to-day, as well as everywhere nearly on the mountains, very abundant; more so than when we passed before. Hundreds of acres of good hay may be cut in Simpson's Park.

Some seventeen Indians have come into our present camp, two of them riding horses. They are Diggers, and speak the Sho-sho-nee language. One of them, who speaks a little English, says the Pi-Utes are to the west of them. These mountains, then (the Pe-er-re-ah range), are the dividing boundary between the Pi-Utes and the Diggers proper. The talk I had with the old Indian I met here before seems to have had the effect of removing the fears of the Indians to come into camp. Some patches of snow visible on the highest portions of the Pe-er-re-ah range, and the probabilities are that it is to be found in spots the year round. The Indians represent the snow in the pass to be in the winter about 15 inches.

Messrs. Lee and McCarthy brought in from Reese River ten brook trout, some weighing 2½ pounds, and represent that just after we left camp this morning there was a very heavy fall of rain in that quarter.

July 7, *Camp No.* 12, *Won-a-ho-pe Creek Cañon.*—Elevation above the sea, 6,285 feet. The guide, Mr. Reese, came into camp at daylight this morning, and reports the route I directed him to examine ahead favorable. The remaining portion of his party are some 75 miles in advance, continuing the examination of the country. Thermometer, at 5.40 a. m., 47°. Decamped at 6.15 o'clock. Continue down the Won-a-ho-no-pe Cañon. A good deal of work necessary in this cañon to make the road good. At present it is miry in places; occasionally for short distances sidling; and in some places, of short extent, rocky. Side-hill cutting generally easy. Currants, red and black, abound in the cañon. Grass abundant; some clover. Piñon abundant on sides of mountain. After journeying 4.8 miles, at 9 a. m. encamp at spring near mouth of cañon and sink of creek. Make only this short march so as to be enabled to reach Wons-in-dam-me Creek to-morrow. Some rain to-day, with thunder.

July 8, *Camp No.* 13, *mouth of Won-a-ho-no-pe Cañon.*—Elevation above the sea, 5,811 feet. Thermometer at 5 a. m., 58°. Leave outward track, and, taking a short cut, join it again in 3.1 miles. Continue on it 1.3 miles, and then leaving it and taking another short cut through a good pass in the Pah-re-ah range, join it again in 18 miles, within 1.3 miles of our old Camp 21, on Wons-in-dam-me Creek, where we again encamp. Journey, 25.4 miles. In consequence of nearly all the road being new, and a great deal of it passing through heavy sage, we did not get into camp till about 6 in the afternoon. Road now, however, on account of having been tracked, good. The Saw-wid Creek, 4.3 miles, and another, 6.8 miles, back from where we are encamped, and which we crossed to-day, are both running streams along the road, and furnish an abundance of pasture up in their cañons. These can be beneficially used by emigrants, who, in that case, should pass on the south side of the small sugar-loaf about 2.5 miles to the southwest of camp, and encamp at the mouth of the cañon.

Some eight or ten Diggers have followed us to camp, each carrying his two rat-sticks. Several of them are entirely naked, except the breech-cloth. Quite a heavy shower of rain has been falling, but, although it came down cold and chilly, these Indians seemed to take it as if it was not an extraordinary occurrence. One of the Indians, who was improperly frightened away at our camp on She-u-wi-te Creek (see journal of May 21 and 22) by my cook, has been again met, and by kind treatment has become reconciled. Indeed, he has performed for us excellent service as a guide, and we have therefore rewarded him with some presents.

July 9, *Camp No.* 14, *Wons-in-dam-me (or Antelope) Creek.*—Elevation above the sea, 6,595 feet. Thermometer at 5 a. m., 53½°. Morning cloudy. Small ambulance, a wheel of which was broken the other day, taken apart and packed in one of the wagons. Moved at 7. Just before leaving, the Indians (some twenty) amused us with a specimen of one of their dances, all entering into it with a great deal of zest, and shouting with the utmost delight. The appearance of so many white men and wagons in their country is quite an epoch in their lives, and they are correspondingly elated.

After proceeding on outward route 1.6 miles, we diverge to left slightly around some foot-hills, and in 5.1 miles come to a couple of springs, which I call Twin Springs. Bearing east of north, half a mile from these springs are half a dozen springs, which I call Barr Springs, after Sergeant Barr, of the Dragoons, who discovered them. These springs, with the grass about them and in their vicinity, would probably suffice for a considerable party. Two miles further we cross our old road, and leave it, not to get into it again, probably, until near Camp Floyd. One mile further reach a spring, which I call Fountain Spring, on account of its welling up like a fountain. Here is an abundance of water of good quality, but the grass is scant and alkaline. There are, however, two or three acres of rush-grass about it, which would answer for a small party. The pools are tinged with red, probably from ferruginous causes. Six and three-tenths miles further across the valley (Ko-bah) we come to a creek, which, on account of the color of the water, I call Clay Creek. The water exists in holes, but is pronounced constant by the Indians. There is a great deal of grass on different portions of it. Train got into camp at half past 2. Ko-bah Valley, such as described in outward route. Journey 16.1 miles. Road good.

Showers all around us to-day, with thunder and lightning, and this evening the rain fell in torrents, and the lightning and thunder were severe. Another beautiful rainbow just before sundown, the third I have seen in the past week. Mr. Reese informs me that these rains at this season are a great anomaly. The ordinary rainy season in Carson Valley is from the last of October to some time in May; and sometimes they have a little rain in June. Mr. Lowry says that in California thunder and lightning are scarcely known. I call the isolated mount just to the west of north of our camp after this last-mentioned gentleman.

As we have probably left our westward route, not to join it again until near Camp Floyd, it is proper here to note that up to the last junction of the two routes, 7.4 miles back from our present camp, we have shortened our outward route, by the short cuts we have made, 21.8 miles; and if the short cut across Ko-bah Valley, noted by the dotted line, which is practicable, is taken, the outward route has been shortened fully 30 miles.

July 10, *Camp No.* 15, *Clay Creek, Ko-bah Valley.*—Longitude 116° 05′ 45″; latitude 39° 33′ 24″; elevation above the sea, 5,998 feet; thermometer, at 5.20 a. m., 51°. First clear, sunny morning we have had for several days. Intending to travel only about 5 miles to reach a better camp-ground, we did not move till half past 6. The rain of last evening, copious as it was, has made but little impression on the soil, so porous and absorbent is it. Immediately at camp, cross Clay Creek by an excellent crossing, and traveling in a northeasterly direction, a range of mountains lying off to our right about 2 miles, in 5.2 miles reach some fine springs (three or four in number), which I call after Mr. William Lee, one of my assistants. These springs are in a narrow grassy outshoot of Ko-bah Valley, and the pasture in the vicinity being abundant, is a favorable place to encamp.

At these springs we found Wilson Lambert and Stevenson, two of the guide party, encamped, drying their clothes. They report that they have been 45 miles ahead, and in consequence of their mules giving out, were not able to join us yesterday. The prospect ahead, according to them, is unfavorable. There is water about 10 miles ahead, and thence about 9 miles beyond, but they both represent the We-a-bah range of mountains, over which the route would lie, impracticable for wagons. Ute Pete, they say, left their party three days since to go to the mail-station on our outward route, in Butte Valley, for the purpose of procuring the Indian who had shown the water before, and has not since been heard from. Here there is apparently a baulk. The guides persist in representing the mountain range ahead impracticable, and it would seem that I am after all forced to join my old route, and go through Cho-kup's Pass, which, on account of its steepness, is not so good as I could like. To strike off from these springs would make the turn in the road too abrupt. I have, therefore, ordered the party to return immediately to our old camp ground of last night, on Clay Creek, so as to make the divergence to old road as slight as possible. Train reached old camp at 15 minutes to 11 p. m.

After returning to camp, I called Stevenson again, and had another talk with him and Mr. Reese about the prospect ahead. He (Stevenson) is not so decided about the new pass in the We-a-bah Mountains being so impracticable as he this morning represented it. I have, therefore, some little hope that we may yet, by a more thorough examination, get through the mountains ahead of us, without being forced to take our old road through Cho-kup's Pass. I have accordingly ordered Mr. Reese, Stevenson, Lambert, and Private Collamer, with two pack-animals and 10 days' provisions, to go again forward and make a more thorough and conclusive examination of the passes. If a practicable pass is found Collamer is immediately to return and report the fact. Rain to-day again around us, and a few drops upon us.

July 11, *Camp No.* 15, *Clay Creek.*—Remained stationary to-day, waiting report from guide's party. The first clear day we have had in 8 days. Took advantage of it to keep up our accustomed astronomical observations. Observed east and west stars for time, Polaris for latitude, and took a double set of lunars, using stars on each side of the moon for the purpose of eliminating errors.

July 12, *Clay Creek.*—Private Collamer came in just after 12 o'clock, (midnight,) and reported, to our joy, a practicable pass in the range ahead of us, on the proposed course of our new return-route. The pass had been found by Ute Pete, who, though he had been four days and three nights without food, except roots, yet had been the instrument of finding us a pass, and thus enabling us to keep on our course. It appears that on his arrival at the mail-station, in Butte Valley, he found it abandoned on account of the spring failing at that point, and the consequence was that he not only failed in seeing the Indian he was in search of, but was disappointed in getting anything to eat.

All hands up at daybreak, but in consequence of the mules having been herded at a considerable distance, we did not get off till 25 minutes of 6. Thermometer, at 4.15 a. m., 42½°. Retrace our steps to Lee's Springs, 5.2 miles, and turning to the right around the point of some low rolling hills, and threading a narrow valley thickly clothed with different kinds of grass of luxuriant growth, in 2.5 miles get into a plain cañon or pass of Colonel Cooper's range, which, in 1.5 miles, leads us into Pah-hun-nu-pe Valley. The rocks of this cañon are quite fine, on account of their abrupt height and well-defined stratification and dip, the latter being about 40° to the northeast. In consequence of the number of swallows which build their nests in its walls, I call it Swallow Cañon. Cedars crown its heights. Leaving this cañon we cross Pah-hun-nu-pe Valley, (elevation above the sea, 5,820 feet,) the cross range of mountains closing it at the south being about 5 miles distant, and the passes through it appearing practicable. To the southwest the ravines in this range are clothed with grass, and water appears to be coursing down them. Six miles from mouth of Swallow Cañon brings us to the sink of a fine creek, which comes from the pass through the We-a-bah Mountains to which we are tending, which creek I call after Mr. Charles S. McCarthy, the indefatigable taxidermist of the party. We turn southwestwardly up along this creek, and in 2.1 miles, at 1.15, reach a locality where, amid excellent and superabundant hill and bottom grass and good wood fuel, we encamp. The stream at this point is 3 feet wide and 1 deep, and flows with a rapid current in a tolerable deep bed.

Road, to-day, excellent; journey, 17.3 miles; soil, for first 3 miles in Kobah Valley, a rich grass or meadow bottom; in Pah-hun-nu-pe Valley it is argillo-arenaceous, in places gravelly; sage the characteristic; cedars cover the mountains. The grass extends up the hills of the We-a-bah range as far as the eye can reach. Indeed, the valley of McCarthy's Creek furnishes the best exhibition of mountain and bottom grass I have seen. It is almost inexhaustible. Large quantities of bottom-grass could be cut for winter. Cedar fuel, convenient, as also good limestone in lower portion of McCarthy's Cañon, and a whitish tufa in lower portion, good for building purposes, available. This tufa so soft as to be easily sawed into blocks of suitable size, and so light as to be easily transported. Indeed, there are all the requisites in this valley of a good dragoon post, which, on account of the altitude, should be kept as low down the creek as possible.

The formation of the mountains to the south of Clay Creek are an altered impure limestone, probably of the Carboniferous period, also altered sandstones.

July 13, *Camp No.* 16, *McCarthy's Creek, We-a-bah Mountains.*—Elevation above the sea, 6,184 feet; thermometer, at 4.30 a. m., 54°. Decamped at 5 minutes of 5. Continue up McCarthy's Creek, the grass continuing along and on the neighboring heights in the greatest abundance and luxuriance. The flowers in the valley, as we approach the summit, are of various colors, and very beautiful. Some aspens and wild currants are also seen. The creek continues to within a mile of summit, which is 6.2 miles from last camp. Pass rocky near summit; grade all the way up very good. Some few patches of snow visible on highest portion of range. Elevation of summit of pass above the sea, 7,270 feet.

Went to higher point on right of pass to get an extensive view. To northeast, east, and southeast could see the country for probably 60 miles, chopped up with mountain ranges, running generally north and south, exhibiting passes between them. The valley immediately to the east of us shows a clay flat, denuded of vegetation, and looking arid. Cedars abound in the mountains nearly everywhere.

We find the descent from pass to valley, east side of We-a-bah range, steeper than we have just come up, on west side, but still not objectionable, though a little sidling. About a mile from summit strike a small, swift mountain stream, 3 feet wide, ¼ deep, which we follow down into the main valley, which I call after Maj. Don Carlos Buell, assistant adjutant general. The stream I call after Capt. Thomas H. Neill, Fifth Infantry. Grass continues abundant in the cañon of this stream. At mouth of cañon, about 1.25 miles from summit, turn northwardly up west side of Buell Valley through an extensive grove of cedars, and in 7.9 miles reach a small stream, which I call Bluff Creek, on account of the imposing bluffs of the cañon, through which it debouches from the We-a-bah range into the valley. We encamp on this creek at quarter of 1 o'clock, after a journey of 15.5 miles. Road good, except for short distances in pass on west side, where it is rough on account of rocks. There is an abundance of grass in Buell Valley, not far from camp. The stream upon which we are encamped, like all others in this great basin, sinks a short distance from its debouchment into the valley. There is another and larger stream, about three-fourths of a mile to our north, running down from the mountains into Buell Valley.

On our way to-day we met Stevenson, of guide-party, who had been left behind by guide-party with a broken-down mule. About 3 o'clock Mr. Reese came in and reported water and grass ahead of us about 30 miles. Pete and Lambert are still ahead looking up points of route. The pass immediately to the west of us, by Bluff Creek, has been examined to McCarthy's Creek, and found to be only an indifferent pack-route. An Indian trail passes this way.

The formations along McCarthy's Creek are limestones so much fused as to come very nearly under the head of igneous rocks. At the summit of the pass siliceous conglomerates obtain, and they continue down to the east foot. Near our present camp limestones, partly pure, and partly subcrystalline, and partly impure and slaty, crop out, and by some fossils found in them are recognized as belonging to the Devonian age, rocks of which age have not been known before to exist west of the Missouri only to a very limited extent.

July 14, *Camp No.* 17, *Bluff Creek.*—Elevation above the sea, 5,998 feet; thermometer at 4.30 a. m. 56°.50. Raised camp at 10 minutes of 5. Strike eastwardly across Buell Valley. This valley, apparently limitless at north, open in places at south. In 6.4 miles reach a point in mid-valley, where I put a ☞ pointing to mouth of Neill's Cañon, as follows:

TO GOOD CAMP AND ROAD, 8 MILES. ☞

(A short cut.)

By this cut-off about 6 miles can be saved. Proceeding 6.7 miles farther, we commence going up pass over a low ridge, dividing Buell Valley from the adjoining valley lying east of it, which I call Phelps Valley, after Capt. John W. Phelps, Fourth Artillery. In 1.8 miles reach summit (6,523 feet above the sea) by a gentle grade, and in 1 mile east foot, also by an easy descent. Then striking northeastwardly, 8.1 miles across Phelps Valley, brings us to the west foot of the Too-muntz range of mountains, dividing Phelps Valley from Butte Valley. Ascending this range 8.3 miles, by an excellent grade through a winding cañon, we attained the summit of the pass, a quarter of a mile below which, on east side, we encamp, at the foot of a conspicuous bluff called by the Indians, on account of its dark basaltic color, Black Head, or Too-muntz Mountain. Here is an icy-cold spring, and about half a mile farther down, or to the east, a small stream to which we drive our stock. Good grass in vicinity. The spring I call Summit Spring. Elevation of summit of pass above the sea, 7,103 feet.

Buell Valley, in spots, is entirely denuded of vegetation, and presents the appearance of a clay flat; elsewhere it is covered with small *artemisia* and rabbit-bush. Phelps Valley appears closed by a cross-range at south, about 6 miles off; at north, the range closing it is about 15 miles off. Soil argillo-arenaceous. Small sage the characteristic. Small cedars in the passes of the ranges we have crossed to-day. The journey has been 32.4 miles, too long a day's travel, but necessary to get to water. Road good. Train reached camp at 8.30 p. m.

July 15, *Camp No.* 18, *Summit Spring, Too-muntz range.*—Longitude, 115° 12′ 14″;

latitude, 39° 32′ 53″; elevation above the sea, 7,057 feet; thermometer at 9.30 a. m. 72°. The guide and Stevenson left this morning early to find water, if possible, about 10 miles ahead, and if they return in time, we are to move that distance to-day. Mr. Engelmann and myself left at 8.30 o'clock to make some observations from some high points to the south of camp. After a hard struggle attain top of bluff (Black Head) and get views of country from 60 to 100 miles around. West of north, far distant, where are the high snow-clad summits of what, doubtless, is the Humboldt range. To the west the We-a-bah range appeared quite near, though quite 30 miles off. To the southwest could be seen, evidently, the Antelope range, at the foot of which we encamped July 8, seven days ago. To the south, for 60 miles, mountain-range after mountain-range appeared running in every variety of direction; and to the east, some 30 miles off, a number of parallel ranges trending generally north and south. Between the east and west ranges there seems to have been an upheave of igneous rocks breaking the sedimentary rocks and causing the irregularity of trend of the ranges, and this seems also to have been the case to the south of us. These rocks are of a brown porphyritic character. To the north of our camp the formations are the same yellowish limestones of Carboniferous age which were before found on both sides of Long Valley. As far as the eye can reach to the south of us the mountains are covered with cedars, which is almost a sure indication that water and grass also exist in that region. Got back to camp at half past 11. At about 5 the guide, Pete, and Stevenson, returned to camp, and reported water 12 miles ahead, and also 3 miles beyond that.

July 16, *Camp No.* 18, *Summit Spring*, *Too-muntz Mountain range.*—Thermometer at 4.40 a. m. 53°. Move at 5, and continue eastwardly down cañon to Butte Valley. In 1 mile from camp pass a fine gushing spring, which issues from foot of bluff, and gives rise to the small stream referred to before, which, after running a third of a mile, sinks. This spring, creek, and cañon I call after Pete, the Ute Indian, who has been of so much service to us in our explorations. The bottom-grass along it, as also the bunch-grass in the vicinity, is abundant.

The grasses I have noticed along the route at different times and in different localities are as follows: First, the very fine mountain-grass, the fruit of which is very small and pretty. This grass attains a height of 1½ to 2 feet. Second, the slightly coarser mountain-grass, existing, like the other, in bunches, but showing larger fruit. This attains a height of about two feet. These two kinds are found chiefly on the mountain benches and slopes and in the ravines. Third, the rye or wheat grass. Fourth, the large high bunch-grass which is principally found on benches along streams, and attains a height of from 3 to 4 feet. Fifth, the sage-grass, very seldom seen, but found among the *artemisia*, or wild sage; and which grows about 1½ feet high. Its fruit resembles, in the husk, the wild wheat. Sixth, the desert-grass, small, fine, and presenting a glossy kind of blossom or fruit. Its height is about 8 inches. The animals prefer the mountain-grass or the first two kinds to all others, and these abound generally on both our routes.

In three-quarters of a mile from Pete's Spring reach mouth of cañon by gentle descent, and 10.9 miles more cross Butte Valley, (6,268 feet above the sea,) with low range of mountains, 5 miles off, limiting it at the south, and strike a stream of pure cold water which I call after Dr. Garland Hurt, the late accomplished Indian agent for the Ute Indians. The stream is tolerably rapid, 3 feet wide, ½ foot deep, and sinks ½ mile below mouth of cañon. Willows line it, and piñon is found on the heights. Currants grow in the cañon. Ascending the cañon by a good grade, albeit in some places a little sidling and rocky, 3.2 miles brought us to the summit of the pass of the Mon-tim range dividing Butte and Steptoe valleys; elevation of summit above the sea, 7,398 feet. Descending the eastern slope by a winding cañon of pretty steep grade for 200 or 300 yards, near summit, 3 miles more in a south direction brought us to a spring, where we encamped. At this spring we have made several excavations, which can be multiplied to any desirable extent, as the spring is running, and the excavations will fill up with water. The guide also reports four more springs within the compass of half a mile from camp. I have therefore called this cañon Spring Cañon. Grass abounds about the camp. Mon-tim range, in which we are encamped, is covered with tall trees, like the fir, which would supply poles for the telegraph for a long distance. The mountain mahogany also exists near our camp in larger quantities than I have before seen it. Brown porphyry characterizes, geologically, Hurt's Cañon; while the main portion of the Mon-tim range consists, like those farther north, of compact calcareous rocks and some few sandstones. Road, to-day, generally hard and good. Journey, 19.1 miles.

July 17, *Camp No.* 19, *Spring Cañon.*—Elevation above the sea, 6,828 feet; thermometer at 5 a. m., 43°. The air this morning very chilly. Decamped at 25 minutes of 6; continued in an east of south direction down Spring Cañon, the grade of which, except near summit, is exceedingly slight. This cañon gradually opens to 2.5 miles wide as you descend to Steptoe Valley, and the cedar on either side is almost inexhaustible. There is grass everywhere in the cañon and on the mountain-slopes, though it is not near so flourishing and thick as that in McCarthy's Cañon. Springs also common in it. On the north side of the cañon the mountains are very bold and precipitous. There is an old beaten trail down this cañon, about the largest we have seen on the trip. The Indians say it is the trail of the To-sa-witch band of the Sho-sho-nees, living about the Humboldt River, who yearly take this route, to trade horses with the Pahvant Indians about Fillmore. These horses they probably get from the Bannacks, to the north of them.

Just at outlet of Spring Cañon into Steptoe Valley, 8 2 miles from camp on north side of cañon, there is a spur from the north wall or mountain of the cañon, through which there is a gap, gate, or cañon, which, for sublimity, on account of its confining walls, equals, probably, anything we have seen on the route. The walls are composed of a siliceous limestone, interstratified with shale, and are nearly vertical. There are several caves, niches, and benches to be seen high up in the wall. The bottom of the cañon is quite springy and covered with a luxuriant grass. Fine grass also exists in the vicinity. I call the place the Gate of Hercules, on account of its stupendous walls. The echo in it is very fine, and our fire-arms have startled a great number of swallows and hawks. The road leaves this gate to the left about 0.5 mile, and 1.7 miles further down Spring Cañon brings us to Steptoe Valley, which we follow, on its western side, for 4 miles, in a southeasterly direction, and encamp on a noble creek, which I call after Lieut. Alexander Murry, the energetic officer in command of the escort of my party. This stream heads some 12 miles off in the mountain range, is rapid, and, after running in a northeasterly direction, sinks 2 miles below camp. At this camp it is from 6 to 10 feet wide and about 1 deep; bottom gravelly and rocky. The grass in the vicinity of our camp, along the bottom of the creek, in the valley, and in the mountains, is exceedingly abundant. Currants are found on the creek. Road, to-day, good; soil, argillo-arenaceous; the wild sage and rabbit-bush the characteristics of the valleys, cedars and firs the mountains. It is very possible that a cut-off may be made from the mouth of Neill's Creek to the mouth of Stevenson Cañon, when the road is perfected; and the intervening country should be examined for the purpose.

July 18, *amp No.* 20, *Murry's Creek, Steptoe Valley.*—Elevation above the sea, 6,193 feet; thermometer, at 5 a. m., 46°. Moved at 20 minutes after 5; course, southeastwardly, across Steptoe Valley. Two miles and eight-tenths from camp get into and follow a wagon-road, which, an Indian who lives in this valley says, was made by the Mormons in the spring of last year. He represents that they came into Steptoe Valley from the east; had about 50 wagons, and after proceeding north of our camp some 8 or 12 miles, turned into a cañon of the Un-go-we-ah range, whence they turned back and retraced their old route to the settlements. I have no doubt that this was the route taken by the Mormons at the time it was reported they were flying from our troops last spring, and were going to Silver Mountains. This is the route that Lott Huntingdon, a Mormon mail-agent at Ruby Valley, reported to me as one which had been traveled by some emigrants in an attempt to reach California from Fillmore, and that nothing more had ever been heard from them! (Mr. Bean, August 10, informed me that he, Bean, was one of the guides to the Mormons, on the occasion referred to above, and that they had 14 horse and mule teams, and about 30 ox teams, and that they returned because they did not like the country.)

About a mile from where we struck the Mormon road, we cross a fine creek, which I call after Capt. Carter L. Stevenson, of the Fifth Regiment of Infantry. This stream comes from the Un-go-we-ah range, and, after getting into Steptoe Valley, runs northwardly in it for 3 or 4 miles below where we crossed it, and sinks. It is 5 feet wide, 1½ deep, of rocky bottom, rapid current, of milky hue, its taste good, and would be serviceable in irrigating the rich bottom along it. Indeed Steptoe Valley in this locality exhibits a very extensive bottom of luxuriant grass, intermingled with clover, and if not too cold (it is 6,146 feet above the sea, or 1,286 feet above Camp Floyd), as both Murry Creek and Stevenson Creek could be used in its irrigation, it would furnish an excellent location for a post or Government farm. An abundance of hay could be cut for the winter, and possibly the cereals (except corn), as well as garden vegetables, would thrive. The fort or post could be located on either Murry or Stevenson Creek, though the former, probably, on account of its being on the west side of the valley, and therefore the freest from snow in the winter, would be preferable as a site. The Indian living here says the snow in the valley is only generally about six inches deep, and some winters there is none at all. It never lasts long. In Spring Cañon Pass of Mon-tim range, it is about 2 feet deep. Should the Government ever locate a post here, the military reserve should be bounded by the highest crests of the Mon-tim range, limiting Steptoe Valley on the west; by the highest crests of the Un-go-we-ah range, limiting said valley on the east; and by an east and west line across said valley from crest to crest, 10 miles north of post; and by an east and west line across said valley from crest to crest, 20 miles south of post. The reserve should be thus large to embrace the necessary pasture and timber. Good building-stone can be got from the mountains, and tall pines or fir from the same source. If preferable, adobes could be used instead of stone. The Indian referred to reports another stream as large as Murry's Creek, to the south of our camp, and which also flows from the Mon-tim range.

After crossing Stevenson Creek we left the Mormon road (which goes around by the way of the mouth of the cañon, through which the creek flows,) and cut across some short and rather steep hills, crossing the river again 7.5 miles from last crossing, up in the cañon, and joining again and following the Mormon road up the cañon from this point. The stream at this last crossing was so miry as to make it necessary to take the teams over by hand. In one-half mile we crossed it twice again. At the last crossing the road, instead of passing where it does, through a narrow miry cañon, should keep straight ahead and turn the hill of rocks about 200 yards higher up.

This cañon discovers some splendid rocks of the most massive character, some of them being isolated and looking like castles. In one instance, on right side of cañon, high up, I noticed a very pretty arch, through which I could see the blue sky. There is a great deal of fine-grained colored limestone here, which, I should think, might be classed among the marbles. A great deal of it is diversified with white streaks coursing through it.

A mile and a quarter from where we last struck Stevenson's Creek, we again leave it and take up a branch ravine, which we follow for 2 miles, and encamp at a fine spring, the source of the branch, among good luxuriant grass and timber.

This Stevenson's Cañon requires four good bridges of spans, from 12 to 20 feet, to make the road passable, and in two places, where the bottom is miry for about 100 yards, the road should be excavated along the side-hills. In point of grade the cañon is excellent, and abounds in grass, cedar, pine, mountain mahogany, and aspen timber. Road good, except at points noted. Journey 14.5 miles. In consequence of bad crossings, train did not reach camp till 4 p. m.

July 19, *Camp No.* 21, *Stevenson's Cañon, Un-go-we-ah range.*—Elevation above the sea, 7,443 feet. Thermometer at 4.40 a. m., 52°. Sent out guide-party early this morning, with particular instructions to send back a man daily to inform me of the country ahead. We are approaching, doubtless, the most difficult portion of our route, and I feel anxious that there shall be no *faux pas.* The party goes out with ten days' provisions, and, besides the usual persons (Reese, Stevenson, and Lambert), I have ordered three soldiers to accompany them. Pete also accompanies them for a distance, and then is to push on with all dispatch with my report to General Johnston, at Camp Floyd.

Main party moved at 5.45. Course eastwardly up branch of Stevenson's Cañon, 1.7 miles to summit of Un-go-we-ah or Pine range, and thence down a cañon I call after Capt. Henry Little, Seventh Infantry, 7.4 miles to its debouchment into Antelope Valley. Thence 6.6 miles, or about two-thirds of the way across Antelope Valley, to some springs, which, by being opened, may be made to serve a large command. We encamp at these springs at 2.15 The road near the pass of the Un-go-we-ah range, on west side, has two or three short, steep, as well as sidling places, which require grading. The general ascent, however, of the cañon from where we struck it is good. The mountain mahogany is found in it. On the top of the pass I noticed four dug holes, evidently places in which the Mormons had *cached* some of their property when they passed here in the spring of 1858, but which now were empty. The distant view, from this summit, of mountain ranges, peaks, and valleys, lying to the southeast, very beautiful. The descent immediately at summit, on east side, tolerably steep, but good the rest of the way down to Antelope Valley. A couple of fine peaks are visible on right of cañon; also other notable rocks, some of them being fine massive exhibitions of a species of veined limestone. These rocks contain small caves. A spring and fine grass are reported by Sergeant Barr, 1.5 miles down the cañon and a quarter of a mile to right, in a branch cañon, and another spring about 3 miles down the cañon to the right, also in a branch cañon. Cedar and pine abound in the mountain range. As you descend Little's Cañon to Antelope Valley, the Go-shoot, or Tots-arrh, range looms up toweringly in front of you, the most conspicuous portion being Union Peak. Antelope Valley, in which we are encamped, exhibits a much better soil in this portion of it than where we crossed it on our outward route. To the north, commencing about three-quarters of a mile from our camp, a bottom of good grass (a great deal of it red-top), 2 or 3 miles wide, extends for a distance of 8 or 10 miles northwardly, and probably further, and intermingled with it are extensive groves of tall cedars, which thus far on our routes, existing, as these groves do, in the *bottom* of the valley, is quite an anomaly. Birds frequent these groves, and make the air resonant with their music. The scenery, too, is quite pretty. This valley is 5,633 feet above the sea, and therefore 513 feet lower than Steptoe Valley where we last crossed it. It is not, however, so well watered as the latter, neither is the grass so luxuriant. There are, however, some fine cold springs which we will pass to-morrow, about 2 miles up Turnley's Cañon, and 8 miles to the northeast of this camp, which might be useful were a fort established in this valley. Adobes could be made or building-stone (limestone) got from the mountain. Road to-day generally good. Journey 15.7 miles. A little rain just before sunset.

The Un-go-we-ah Mountains, in the neighborhood of our route, are composed of calcareous rocks, mostly an impure limestone, with some slaty and other strata. Near the summit the rocks are porphyritic.

July 20, Camp No. 22, Springs, Antelope Valley.—Longitude, 114° 26′ 52″; latitude, 39° 06′ 09″. Elevation above the sea, 5,633 feet. Thermometer at 4.40 a. m., 54°. Weather quite mild at sunrise and during the night. Decamped at 20 minutes past 5. Course east of north, 5.8 miles up Antelope Valley, to mouth of cañon, which I call after Capt. P. T. Turnley, assistant quartermaster at Camp Floyd, and which leads us to the pass over the Go-shoot or Tots-arrh range. Our road turns up this cañon southeastwardly, and 2.2 miles from mouth we find some fine copious cold springs, which I call also after Captain Turnley. Grass and wood-fuel found in vicinity. Persons traveling our route will find a road to the north of ours, and more direct from near the mouth of Little's Cañon to the mouth of Turnley's Cañon, which will cut off several miles. In that case they will make their encampment at these springs, and not where we did in Antelope Valley. Proceeding up Turnley's Cañon 1.8 miles by a remarkably easy grade, the cañon being amply wide, we reach summit of pass of the Go-shoot or Tots-arrh range (7,060 feet above the sea), whence we had toward the east a fine view of some distant mountains, Union Peak of the Tots-arrh range to the east of the summit towering far above every other height, and showing a great deal of snow and apparently depending icicles in its recesses. Indeed, I think this peak the highest we have seen on either of our routes. Descending from pass on east side, by a cañon of very easy inclination, in 7.2 miles reach a fine spring of flowing water, where we encamp. This cañon I call Red Cañon, on account of its red-colored rocks. The spring is called by the Indians Un-go-pah, or Red Spring. Plenty of grass exists near and in vicinity, and I notice also some springs to the south side of us, in the cañon, about 2 miles off. Union Peak, which lies some 10 or 15 miles to the west of south of us, the Indians call Too-bur-rit; but I cannot learn its meaning. The mountain range is covered with cedar, piñon, and fir. Road to-day very good. Journey 17.1 miles. Train got into camp at 12.45. Met Private Marpool, of guide's party, before reaching camp. He had returned from the guide's party to conduct us to our present camp. Pete we found at this camp. His mule had given out on account of sore feet, and he was waiting our arrival to have him shod. Private Nune also came into camp from guide's party to conduct us to our camp-ground to-morrow. Pete has been supplied with a fresh mule, and at 3 p. m. he started again on his way to Camp Floyd, the bearer of my report of progress. An elk was seen for the first time yesterday in Stevenson's Cañon, and one to-day in Red Cañon; also, a mountain sheep for the first time.

The Tots-arrh range, on west side, is composed of altered limestone and quartzite. The limestone forms the mountains on both sides of summit of pass. On east side, along the road, was noticed a great deal of calcareous conglomerate; also, quartzite and impure limestones.

July 21, *Camp No.* 23, *Un-go-pah or Red Springs.*—Elevation above the sea, 5,927 feet. Sergeant Miller and Corporal Duvall came in during the night with the beef which was found missing when we reached Camp 21. This is the only beef remaining, and is one of those we took from Camp Floyd, and he has improved ever since we left that post. Thermometer at 5 a. m., 61½°. Resumed journey at 25 minutes after 4. Course eastwardly. Continue to descend Red Cañon to valley on east side of Tots-arrh range, which valley I call after Deputy Quartermaster-General George H. Crosman, stationed at headquarters Department of Utah. The road we are following, and have been since we left Steptoe Valley, is the Mormon road referred to July 18. The indications are that some fifty wagons have been over it. The tracks of the cattle are still visible, and the dung yet remains on the road. About 3 miles from camp we leave the road, to cut off a bend of it. About 2.5 miles farther cross a dry branch just below its sink. Cottonwood at crossing. Five and a half miles farther brings us to a rush spring of tolerable water, which, by excavation, could be made to serve a pretty large command. There is a great deal of grass about it, and in the vicinity. Three and a half miles farther we join and follow again the Mormon road. Half a mile farther we come to creek, 3 feet wide, 1 deep, which comes from the south, and sinks a quarter of a mile below camp. In places it is lined with rushes and willows. On this creek, which I call also after Colonel Crosman, we encamp at half past 12, amid abundance of grass. This valley, which, like nearly all the others, lies north and south, is 12 to 15 miles wide, and is partially closed at either end by high mountains, some 25 or 30 miles off. Its elevation above the sea is 4,920 feet. It has a great deal of grass in it, in localities, and is at these places supplied with springs, which are either copious or can be made sufficiently so. Small greasewood the characteristic. Road to-day generally very good, sometimes cutting up from alkali. Soil generally gravelly. Journey, 14.8 miles.

July 22, *Camp No.* 24, *Crosman Creek.*—Elevation above the sea, 4,920 feet. Thermometer, at 5 a. m., 65°. Cloudy this morning at sunrise, and a few drops of rain. The mules during the night gave indications of a stampede. At first supposed it might have been caused by some Indians, who acted as if they were angry last evening because they were not permitted to remain in camp after dark; but as such indications are not unusual, it was probably due to other causes. The guard, however, was visited and admonished to observe vigilance, &c.

Moved at 5, and continue on Mormon road. Course, northwardly in valley for 10.2 miles, when we come to a number of small springs, which I call after Lieut. Peter W. L. Plympton, Seventh Infantry. These springs at present do not afford a great deal of water, for the reason of there being no proper excavations, but a great sufficiency could be easily obtained in this way. The soldier who last joined us at Un-go-pah Springs was directed by the guide to conduct us to a spring 12 miles distant from our last camp, but as these are only 10 miles distant, and the soldier has not been to the place, we continued on in the hope of seeing the springs referred to within about a couple of miles and camping at it. It proved, however, that at this distance there were no springs, so that I was lured on in the hope of finding them a little farther on. At 13, 14, and 15 miles from camp we saw none, and then, according to the notes of the guide, which he had shown me, feeling confident that they were beyond, in striking distance, I continued on till, at quarter to 5 o'clock, we had traveled 30.1 miles, when we were obliged to encamp near some puddles of water, which had been made by the rain, just before we reached the spot. The misfortune is, too, that there is no grass in the vicinity, but the barley we purchased at Placerville now comes into requisition, and we shall thus be enabled to get through the night.

After reaching, as above stated, Plympton's Springs, our route lay eastwardly 6.7 miles to foot of pass, across a low, thirsty mountain-ridge, which I call Perry Range; thence 3.1 miles by a good grade, up a broad cañon to summit, the rocks on the left side being buttress or bluff-like; and thence, by gentle descent 10.1 miles to camp. The ridge we have passed over is composed of highly altered silico-calcareous rocks, and is almost entirely bare of trees. From the summit of the pass, 5,657 feet above the sea, could be seen, some 25 or 30 miles off, on east side of range of mountains, quite remarkable on account of its well-defined stratification and the resemblance of portions of its outline to domes, minarets, houses, and other structures. On this account I call it the House range. Between it and the ridge forming our point of view is a very extensive valley, very generally white with alkaline efflorescence, and I have therefore called it White Valley. It is some 25 miles wide, and partially closed north and south by low ranges, about 15 miles off. Soil, areno-argillaceous. Small greasewood the characteristic. It is in the middle of this valley we have encamped, and on account of the guides having neglected to send back a man, as he was wont, according to orders, to point to me a camp of *which he was personally cognizant*, the party is in its present uncomfortable situation.

July 23, *Camp No.* 25, *White Valley.*—Elevation above the sea, 4,406 feet; thermometer at 5 a. m., 60°. Koenig, the dragoon, did not come in from the guide party in the night, as was anticipated. I do not understand the guide's movements. It was enjoined upon him over and over again to send us a man back daily, to guide the party with certainty to water and grass, and he has still Pete, Lambert, Stevenson, and Private Koenig with him. It will be hazarding too much to persist in going forward at a venture, though Sanchez, who was with the guide when he examined to the northeast of the House range, on our outward trip, says there is water on the *east* side of the House Mountains. The route to the water, however, is not known to be practicable, and it would consume nearly the whole day to have it examined, and in the meantime the animals are without grass and water, and we cannot afford to give them another feed of forage, it being necessary for the desert stretch, which we may possibly have to pass before reaching Rush Valley. I have, therefore, determined to fall back to Plympton's Springs, where we can get grass and water, and await there the arrival of some one from the guide's party.

Leave at 7 a. m., and retrace our steps to Plympton's Springs, where, at 2, we encamp. Journey, 18.7 miles. At 5 p. m. had a very severe hail and rain storm, the severest I have experienced since I have been in this region; hail as big as marbles, and rain so copious as to flood the tents; thunder and lightning the accompaniments. In these high regions the thunder and lightning, however, are infrequent, and not severe.

July 24, *Camp No.* 26, *Plympton's Springs.*—Elevation above the sea, 4,814 feet; thermometer, at 6.30 a. m., 62°. Private Koenig of guide party has not yet returned. Begin to feel very uneasy, and have, therefore, directed Sergeant Barr, Private Collamer, and Sanchez, the Mexican, to examine the country beyond where we encamped night before last, in White Valley, and see if we can get our wagons to the water reported by Sanchez as lying to the east of House range. Should they meet Koenig, and all is right, they are to continue on to the water, and Koenig is to return and report. Should they not meet him, then Sanchez is to return by the pass to the north of the reputed water, and report the facts. The teamsters and men, meantime, are engaged in cutting grass to take along with us over the desert. Some little rain this afternoon.

July 25, *Camp No.* 26, *Plympton's Springs.*—Thermometer at 5.15 a. m., 51°. Sergeant Barr came in at 11 last night, having ridden 40 miles, and reports that 2 miles beyond our rain-puddle camp (No. 25) he found a note from the guide to me stuck in a cleft-stick near a rush pond, informing me that the Indian with him says there are water and grass 10 miles beyond that locality. This mode of guiding me by notes stuck up, depending upon the contingency of my reaching or getting them, is a new feature introduced by the guide since I have approached the desert, and is entirely unauthorized. It is true that he sent word by Private Nune, the last man he sent in, that I could continue to follow the Mormon road, and that if anything was wrong he would send a man back to notify me. But this is placing me entirely at his mercy, and this I do not choose to sanction. I must know what lies before me. The sergeant alone came back. Collamer and Sanchez continued on to examine the water and grass ahead, and are to return to us at Rush Pond, where the note was found. I have concluded, therefore, to again move forward.

Started at 5.45 and retraced our track to our old camp-ground, No. 25. A mile and a half farther brought us, at 1 o'clock, to the Rush Pond reported yesterday by Sergeant Barr. Journey, 20.3 miles. The rain yesterday in this valley must have been very heavy. The sage-brush has been torn up by the roots and carried as if by a flood down an *arroyo* and lodged on either side clear over its banks. Not finding either Collamer or Sanchez here as I expected, and noticing with my reconnoitering glass two persons coming toward us from the cañon ahead of us, out of the House range, I have ordered a halt till they could come up, and make their report. At 2.30 they arrived, and proved to be Koenig and Sanchez. Koenig reporting water and grass 15 miles ahead, and it being impossible for us to make the distance to advantage to-day, we go into camp where we are, at the Rush Pond. A rather poor camp, but the rushes will prove sufficient for our animals, and the water is sufficiently abundant.

Koenig has come in all tattered and torn. He has been two days without food, and all on account of the guides neglecting to send a man back to report every camp instead of sticking up notes which I might not, and did not, at the proper time, get. His horse giving out, he was obliged to walk a great deal on foot. Collamer and Sanchez happily met him this morning in the cañon ahead, waiting for us, and relieved him of his troubles. Collamer let him have his mule, and remains ahead of us till we can overtake him to-morrow.

Showers of rain around this afternoon, with slight thunder and lightning. There is a spring to the north of our camp, so Sanchez reports, some 5 miles off, near a small mound, or hill, but no grass; he found it when examining the country on our outward route.

July 26, *Camp No.* 27, *Rush Pond, White Valley.*—Longitude, 113° 31′ 54″; latitude, 39° 19′ 37″; altitude above the sea, 4,350 feet; thermometer at 5 a. m., 56°. Decamped at 5.30 o'clock. Continue on old Mormon road, north of east to mouth of cañon, leading to pass through House range. To get to it, cross an alkali flat, 3 miles wide, which, in wet weather, must cut up very much. It can be avoided, doubtless, by bearing around more southwardly. After crossing flat, pass through a mile of sand knolls, where the pulling is difficult. Reach foot of cañon, 8 miles from camp, and 4.1 miles further, by a good grade, except near summit, where for about 100 yards it is rather steep, we reach the culminating point of pass. Elevation above the sea, 6,674 feet. The bluffs at the entrance of this cañon are tremendously high and massive; that on the right very high, probably 1,500 feet, and like a dome. Call the cañon, therefore, Dome Cañon. Excellent and tolerably abundant grass in this cañon, but no water. Cedars and a few firs on slopes of cañon. The walls of the cañon full of small caves, and as usual showing a great deal of the resinous, pitchy substance, that seemingly oozes out of the rock; but it may be the dung of birds or of small animals. The formation of the mountain range is made up of highly altered limestones and some altered sandstones, &c.

Ascended a high point to right of pass to get an extensive view. To the south, some 20 miles off, lies a lake of sky-blue color, apparently some 10 or 15 miles long, and less broad. This is doubtless Sevier Lake, the sink of Sevier River, on which Captain Gunnison and party were massacred in 1853, and to which he was tending for the purpose of examining it when the catastrophe occurred. The valley lying to the north of this lake exhibits one extended low, flat, desert plain, showing many spots of a whitish alkaline character. Coursing from south to north across it, at its eastern portion, some 20 miles off, is a low range of mountains, its north end terminating directly east of my point of view. Far beyond can be seen a continuous range of mountains, running north and south, which doubtless is the formidable Wahsatch range. The prospect of palatable water directly east is poor indeed.

After descending from summit on east side, about two miles, met Collamer, who conducted us up a cañon to the left about half a mile, when we came to a fine cold spring of good water, where, at 12.45, we encamp. Road to-day excellent, except across alkaline portion of the White Valley as stated. Animals driven to the creek, up the cañon about a mile from camp, where there is a considerable quantity of fine grass and a growth of pines. Journey 14.5 miles. This spring, creek, and cañon I call after Lieut. Gurden Chapin, Seventh Infantry.

Met the guide, Mr. Reese, at this camp ground. He arrived here yesterday afternoon without food. Reports water and grass 15 miles ahead. The rest of the party, Pete, Lambert, and Stephenson, are awaiting us at that locality; their animals all broken down from sore feet. They had been two days without water. The guide had been unsuccessful in finding the water pointed out in the distance on our outward route by the red-shirted Indian (Black Hawk's brother) in the Short-Cut Pass range, although they were engaged two days looking for it. This was the water which was to shorten the distance between water on the desert to 35 miles.

Persons following us may suppose that, from Rush Pond, we might have come more directly to our present camp, by the pass just to the north of us, in the House range; but besides White Valley not being practicable, on account of alkaline mire in that direction, the pass referred to is not practicable for wagons. This pass was examined by the guide-party on our outward route.

The old ox which remained of those we took from Camp Floyd, on our way out, was slaughtered for beef this evening, and not without considerable regret. He had traveled with us the whole way, and we felt reluctant at parting with him even for beef.

July 27, *Camp No.* 28, *Chapin's Spring.*—Elevation above the sea, 6,530 feet. Thermometer at 5 a. m., 67°. For the last 2 nights the weather has been quite warm. Marched at 20 minutes past 5. Retraced our steps one-fourth of a mile to old Mormon road, and then leave it and cut off an unnecessary detour, by winding in the cañon to the left. Three and a half miles further get into it again, in Sevier Valley, and after following it a few yards, leave it entirely, we turning to the left around a southeast spur of the House range, and the Mormon road continuing in an easterly direction to Fillmore and crossing the Sevier, it is said, at the Government bridge on the main southern road to Los Angeles. It is from the point of mountain at this locality that the view of Sevier Lake has been taken. A low mountain range bounds the lake on its south shore; but on its north, the valley goes down to it without any intervening hill or ridge, and it looks traversable by wagons in every direction. Continuing around along the east base of House range our route, after proceeding northwardly up the valley about 11 miles, turns to the left up a cañon a quarter of a mile, where we reached some good springs, and at 12 meridian, encamped. In this vicinity there are other springs, and about half a mile further up toward the mountain, there is a small creek, 4 feet wide, 1 deep, which, after running a short distance, sinks. The springs' creek, and cañon I call after Lieut. Charles H. Tyler, Second Dragoons. To this creek, along which there is an abundance of grass, we drive our mules.

At this camp we found Pete, Lambert, and Stevenson of guide's party, all broken down, on account of animals giving out. At 6 p. m. I dispatched Pete, Stevenson, and Sanchez about 75 miles ahead, to look up pass into Rush Valley, suitable for this, our return, route. Pete is to continue on to Camp Floyd with my report and letters, and bring back the mail.

In Tyler's Cañon, a short distance to the north of our camp, is an artificial corral or inclosure made of rocks, and capable of holding about 50 horses. It is represented as being the place were Tintic, an Indian chief, a year or two ago concealed a lot of stolen horses.

Journey to-day 15.5 miles. Road stony along east base of House range, otherwise good.

July 28, *Camp No.* 29, *Tyler's Spring.*—Elevation above the sea, 5,992 feet. Thermometer at 6 a. m., 72°. Remained in camp till 2.30 p. m. for the purpose of recruiting the animals, preparatory to crossing the desert, and traveling all night. Take a course northwardly for about 15.6 miles up a branch or arm of Sevier Lake Valley, where we, about 11 o'clock, stopped to take supper and bait the animals with some grass we had brought with us. From this point we bore off northeastwardly to a pass through Colonel Lorenzo Thomas's range, 3 miles, by an easy grade, bringing us to the summit, 5,520 feet above the sea. Descending on east side by a good grade, 2.2 miles more, we halted, at 3 o'clock in the morning, to take breakfast, and feed the animals with barley. There being no moon, and it being cloudy, it was somewhat difficult for us to find our way through the pass; but, by the use of a lantern ahead as a guide to the foremost wagons, we were enabled to get along better than I expected.

At 4.15 a. m., July 29, we left our place of bivouac, and in 2 miles reached second summit of range, 5,330 feet above the sea, whence, bearing magnetically north 25 E., could be seen the Champlin Mountains, for the water in which we were aiming. It was in the region of this summit, southward, that the red-shirted Ute Indian had, from a distance, pointed out the locality of a spring; but, as I have already in my journal stated, although the guide-party had spent two days in looking for it, they had not been able to find it. The consequence is that we are obliged to push on farther for a good camp-ground. The route we have come from Tyler's Springs, evidently a crooked one, in Colonel Thomas range; and besides, it makes too great a detour to the north. The true route should evidently pass the range 4 or 5 miles to the south of us, and the indications are, there would be no difficulty. The guide, though he has examined these passes twice, has bungled a great deal to-day. At half past 9 a. m., being about 5 miles in advance of column, hurrying on alone over the desert to the east of Thomas range to examine a pass ahead, I heard a halloa from some one in rear, whom I found to be Mr. McCarthy. He brought me the intelligence that Stevenson had returned and reported a small spring and some grass to the right of the route we were pursuing, and about 6 miles from the train; also another spring, or rather a couple of springs, 6 miles beyond that again, in the mountains. In consequence of this, I immediately sent word to Lieutenant Murry to divert the train to the first mentioned spring, going there also myself. I found, however, at the locality two trifling springs of no value, the water even by digging not being sufficient for half a dozen men. Besides, it had a very poor taste.

These springs proving of no value, after resting the mules and putting in fresh ones for those broken down, we attempted to reach with our wagons the springs reported by Stevenson, 6 miles farther on. The teams, however, were too much fagged out to accomplish it, and the consequence was that late in the afternoon, after proceeding 3 miles, we were obliged to halt and encamp for the night in a locality near some triple peaks, where there was neither grass nor water. At about sundown the mules were driven to the water and grass supposed to be 3 miles distant, in two herds; Mr. Reese and Privates Shelton and Schwartz with the first, and Private Kennedy, Lambert, and one of the Mexican herders ("the old man") with the other. We have been traveling since yesterday at half-past 2, or for about 30 hours; the weather has been warm, and the mules have had no water. The consequence is that all are fagged out, and we feel that we must reach water soon, or the expedition become demoralized and we fail of getting through to Camp Floyd across the Great Salt Lake Desert by a new return-route, as I had hoped. My dependence, however, is in a higher power, and as He has never yet failed to help me in the straits of life through which I have passed, I am still encouraged to believe that He will yet conduct us safely through our trials and difficulties.

Country to-day and yesterday unusually arid and forbidding. Colonel Thomas' range a combination of trachytic and dioritic igneous rocks and some metamorphosed stratified rocks. Journey from Tyler's Springs 36.9 miles. Road good except the last 3 miles, which have been unnecessarily bad and hilly on account of our not having taken a route from the springs slightly farther to the left over the mountains than we have come. We had, this afternoon, a very copious shower of rain. Stevenson, as soon as he had pointed out to one of our men the next spring, left us to join the guide-party ahead.

July 30, *Camp No.* 30, *near Triple Peaks.*—Elevation above the sea, 5,750 feet; thermometer at 6 a. m., 62°. About 9 a. m. Kennedy came in and reported that the drove of animals he went with last evening did not reach water till this morning. Found the water-hole entirely insufficient without being dug out. Mr. Reese had left in the morning to find the other water-hole. Sent out Sergeant Miller with some shovels to enlarge spring. At 12 meridian the herd Kennedy had been with came in, and the report is that the portion Reese was with had strayed away and could not be found, my horse, which I had let him have last night, of the number. The mules which have been brought in are all put to the wagons, leaving one without a team, which of necessity we are obliged for the present to leave behind. We strike our course northeastwardly to one of the springs we hoped to reach yesterday. The animals look sorry enough, and if they do not get water soon, must perish. On our way we were met by Mr. Reese with the remaining animals. He reports he found the other spring through the happy circumstance of meeting a crippled Indian, who showed it to him, just at the time he was despairing of finding it. It is about a mile to the northwest of the first spring. After proceeding in a general northern direction 5.6 miles, or 2.6 miles farther than Stevenson said it would be, we came to one of the springs and encamped. Greatly to our disappointment I found it affording but a very small quantity of water; scarcely enough for cooking purposes. Every effort was made, however, by cleaning out the cavity, to collect the water with the greatest possible economy; but after all we could do we could only water the animals by successive bucketfuls, and that at intervals of several minutes. At this rate it was evident the animals would die before we could satisfy them. I then visited, with Lieutenants Putnam and Murry, the other spring, about a mile to the northwest, and found scarcely a pint of water in it. Prospect of watering the mules gloomy enough! Notice, bearing magnetically N. 20 E., probably 12 miles off, in the Champlin Mountains, what appears to be a creek and plenty of grass. As soon as possible send all the mules except the weakest, which can be watered here, to said creek, under care of four dragoons and eight teamsters, Mr. Reese and the old crippled Indian we have found here going along as guides. This Indian has his hip out of joint, but was perfectly willing and anxious to go if we would put him on a mule. He was therefore bodily lifted up and placed on the mule, and he went off very cheerfully. The spring which he showed us, and near which he has his wick-e-up, I call the Good Indian Spring, after this Good Samaritan Indian. Certainly such disinterestedness as he has shown deserves at least this small tribute. The anxiety he displayed in his gestures and language to get our animals to water, in our present strait, has been remarkable, and looks like a signal interposition of Providence for our relief. The greater portion of the mules have been without water since about noon day before yesterday, that is 54 hours, and they will not get any till they reach the creek, 12 miles distant, which will take four hours more. It was pitiable to-day to see them huddling together at the spring and eager to stick their noses in it, and yet of necessity forced away with the whip. Some of them were so dry as to eat the moist mud. The weather has been excessively warm, and this has added to the thirst. O, the value of water, and how little it is prized when it is to be had in abundance! These trips across our desert plains make it very plain why such value, in the days of Abraham, Isaac, and Jacob, was placed on wells.

The mountains in which we are encamped I call after Major Irvin McDowell, assistant adjutant-general. It contains an abundance of the finest kind of grass, and is covered with cedars. Its geological formation is igneous. The springs near us are represented by the good Indian as having been made by some horse-thieves (white men) about a year and a half ago.

Our route to-day was across a divide about a mile from last camp, and then down a cañon, to within a mile of Sevier Lake Desert on southeast side of these mountains, and then up a ravine across the crest again of the mountain to the north slope of cañon, leading down to Salt Lake Desert, or Sevier Lake Desert, as the dividing rim is scarcely perceptible. Road good. Journey, 5.6 miles.

This evening, about 9 o'clock, we had a shower of rain, accompanied with pretty severe thunder and lightning. The party driving the herd to water has a dark night of it.

July 31, *Camp No.* 31, *Good Indian Spring.*—Longitude, 113° 56′ 36″; latitude, 39° 46′ 09″; elevation above the sea, 5,771 feet; thermometer at 6.30 a. m., 78°. We have been enabled to water, during the night and this morning, the weak mules that have been left behind of the herd that was driven off yesterday evening. Some of them drank as many as 9 bucketfuls, and yet stuck around the spring until they were driven away. One of them, Sergeant Barr informs me, actually drank, in the course of a couple of hours, as many as 14 bucketfuls before he was satisfied. The truth is, on these dry deserts the whole system of man and beast becomes so arid and depleted, on account of the dry and, therefore, evaporating power of the air upon the fluids of the body, as to require not only a sufficiency of water to satisfy the ordinary demands of thirst, but to supply the dessication of the whole system from this cause.

The wagon which was left at our last camp was brought in to-day. Several of the mules, in their anxiety to get water, got mired in the mud-spring, and had to be hauled out. At 1 p. m. Stevenson, Sanchez, and the son of the good Indian, who had been their guide, came in, and reported they reached the south end of Rush Valley yesterday at 12 m., where Pete left them for Camp Floyd. Stevenson reports in the direction of our route ahead of us water and grass at convenient distances, and the pass across the Guyot range, to the more southern portion of Rush Valley, practicable.

Mr. Reese returned this afternoon, and reports that the herd last night, during the thunder-storm, and in the darkness of the night, in a thick grove of cedars, got separated, and, while the strong animals, under him and the good Indian, pushed forward and reached the water about 14 miles distant, the weak ones had lagged behind and had gone in another direction to find water. He thinks they will be joined together again to-day and be driven back to-morrow.

At 7 p. m. the good old Indian, crippled as he is, came in and discovered by his words and gestures that though he was very much fatigued, yet he had a good heart toward us. He made signs to us to show that his helplessness was such as to make it necessary for him to be lifted bodily from his horse. He was taken off and carried to near the cook fire, and I had a supper prepared for him. All hands feel grateful to him for his extraordinary kindness to us. He had permitted his son, who was his only support and protector, to go away with the guide-party for several days, and now he had done us the signal service, crippled as he was, to conduct our mules to water, and thus possibly save them from perishing and us from failing in this portion of our route. Of course we all felt grateful, and testified it by some presents to him and his son. The fine Spanish knife I gave him he seemed to particularly prize Believing that "Wolf's Schnapps" would prove acceptable to him as a restorative, I handed him some, but he immediately smelt of it and replied, "*No bueno*" (no good), at the same time rubbing his hip, thus indicating that he wished it to be applied there. It was so applied, much to his satisfaction. His only mode of locomotion is on his haunches and hands, just as I have seen children who could not walk propel themselves forward. Of course this mode of progression bore heavily on his hands, which were very liable to be cut by the rocks and rough sage-brush over which he was required to make his way, and he expressed a wish that a pair of gloves might be given him to protect them, which was done. In his case it was gloves that were considered highly valuable for purpose of locomotion through sage-brush; but in the case of the Go-shoot and Digger Indians generally, it is moccasins, which, on account of the great difficulty of entrapping or killing any larger animal than the rabbit, they cannot easily command. Our sympathy for the poor cripple has been such as to suggest a pair of crutches for him, and Mr. Jagiello has manufactured a pair. He is pleased with the present, but makes no attempt to use them. He is treated so much like a king that he looks upon us occasionally with a look of wonder, and seems to ask himself, "Is this attention indeed real?" and then breaks out into a laugh, in which is intermingled as much of astonishment as joy. At his request, I have permitted him to sleep in camp, the only strange Indian to whom this privilege has been granted on the trip.

August 1, *Camp No.* 31, *Good Indian Spring.*—Thermometer at 6 a. m., 66°. The old, crippled Indian is named *Quah-not.* I had him helped up this morning, and the crutches put under him, but, alas! find he cannot stand on either leg. We had thought it was only one leg that was affected, but it appears now that he is paralyzed from his loins down, and this is the reason why he has not availed himself of the crutches. His son's name is Ah-pon.

9 *a. m.*—The mules which were sent to water night before last are momentarily expected, but we think it best to get the mules we have with us to the next water as soon as possible, since the spring where we are is so small that, without the use of troughs to collect and economize the water, but few animals can be watered satisfactorily. The civil portion of my party, with three wagons, therefore, move forward, leaving the balance to follow us as soon as the other mules arrive. Pass down cañon, in a northwardly direction, through a thick grove of cedars, over a rolling country, skirting McDowell Mountains to our right, and in about seven miles reach a desert valley or plain running southeastwardly from Great Salt Lake Valley into Sevier Valley. In about two miles more, reach west foot of bench of Champlin Mountains, and encamp at half past 2 within about two miles of good and abundant water and grass in cañon of the mountains, to which the mules are driven. Journey 9.2 miles; road good. About an hour after getting into camp, Sergeant Miller passed us with the remaining portion of the herd on his way to our old camp. It appears that the herd which became separated night before last only got together this morning. The spring, creek, and cañon near our camp I call after Assistant Surgeon Thomas H. Williams, United States Army

The sunset from our camp this evening superb. The amber hue of the sky, the purple and roseate clouds in the west, and the variegated colors of the clouds in other parts of the heavens, make up a fine view.

About dark, Pete came in with a large mail from Camp Floyd, having first visited our old camp at Good Indian Spring. It was pleasant to see so large a bundle of letters and papers for me; but, alas! the black-edged envelopes of many of them showed that, since the last mail, the insatiable destroyer had been at work.

August 2, *Camp No.* 32, *Williams's Spring.*—Elevation above the sea, 4,558 feet. Thermometer at 6 a. m., 66°. At half past 2 this morning, Lieutenant Murry, with the other portion of our party, joined us. At 5 a. m., after getting breakfast, the whole party moved forward; general course eastwardly, around the southwest base of Champlin Mountains. The rim or dividing line between the Great Salt Lake Desert and Sevier Lake Desert is so slight as to be scarcely perceptible. The Champlin Mountains to our left are abundantly clothed, in the ravines, with grass, and running springs are to be seen in the same localities. Cedars are also abundant. At half past 12 we reach a creek flowing from the Champlin Mountains, upon which we encamp. This creek is four feet wide and a few inches deep; bottom, gravelly; banks four feet high. Grass in abundance on side-hills near camp. I call it after Maj. Henry Prince, paymaster United States Army. The road to-day, in places, stony and rough, and occasionally hilly, on account of ravines. Soil of main valley, areno-argillaceous; benches of mountains, gravelly and stony. The animals have been scarcely able to get the wagons to camp, so much have they suffered for the past few days on account of the absence of water and incessant traveling.

August 3, *Camp No.* 33, *Prince's Creek.*—Elevation above the sea, 5,411 feet. Thermometer at 5.30 a. m., 68½°. Start at quarter to 6, in advance of party for Camp Floyd, Pete accompanying. Continue up Prince Creek for half a mile, and then leave it to left, and pass up a branch cañon, filled with cedars, one-half mile more, to summit of pass. These cañons are of good grade. From summit of pass, by pretty good descent, get into a valley, which I call after Maj. Fitz John Porter, assistant adjutant-general. This is a fine grass valley, and is well supplied with water. It is an excellent valley for stock, both summer and winter. The grove of cedars in it, in which the cattle could take shelter during driving storms in the winter, is quite extensive and thick. I notice that Russell & Co. have a herd of cattle feeding in this and the southern portion of Skull Valley, to the north of it. Proceeding northwardly through this valley, in 2.3 miles cross Porter's Creek; 2.7 miles more brings us to the slight rim or divide between Skull Valley and Porter Valley, and 3.2 miles more to a spring, which I call after Assistant Surgeon Charles Brewer, United States Army. Turning northeast, or to the right, in 2.3 miles you reach, by a pretty good ascent, the summit of the Guyot range, by what I call Oak Pass, about 5 miles south of General Johnston's Pass. This pass leads, across the Guyot range of mountains, to Rush Valley. Chief obstacle to a road in this pass is the oak brush, which, for wagons, will have to be cut away for about half a mile, and the road will have to run in the bottom of the cañon, where it is very narrow, and, in some places, stony. A road, however, can be got through by filling the gully in some places, and enlarging in others. The descent into

Rush Valley from summit, for about sixty yards, is pretty steep; balance easy. Some little filling up of bottom of cañon and at crossings necessary, and a little cutting of oak bushes. Two miles from summit reach east foot of pass in Rush Valley. The southern and southwestern portion of this valley for 8 or 10 miles in every direction is covered with beautiful and luxuriant grass, and so are the bases of the mountains. There are some springs to the south of the pass in the valley. From east foot of pass strike northeastwardly across Rush Valley for Camp Floyd Pass, in 6.7 miles crossing Meadow Creek, a flowing stream, 4 feet wide and 6 inches deep, and along which are good camping places; in about 18 miles more attaining summit of Camp Floyd Pass, and in about three miles more, at 7.15 p. m., reaching Camp Floyd. Road to-day, except as stated, through Oak Pass, good. Journey 44.5 miles. Reported to General Johnston in person same evening.

August 4, *Camp Floyd.*—At my suggestion, by direction of General Johnston, two men, with Pete as guide, and two pack-animals, were sent out this morning to my party. They take four days' provisions for the command, and some sharp hatchets to cut away the oak brush in Oak Pass of the Guyot range. The following orders have been issued:

[Special Orders No. 64.]

HEADQUARTERS DEPARTMENT OF UTAH,
Camp Floyd, Utah, August 4, 1859.

1. The infantry portion of the escort to the topographical exploring party under Capt. James H. Simpson will be replaced by one non-commissioned officer and ten privates from the same arm of service at Camp Floyd. This detachment will be formed from those men of the command whose term of service will expire in or about the month of November.

The detachment from Company A, Second Dragoons, will continue to form part of the escort, and join the company at Fort Kearney.

Second Lieut. Alexander Murry, Tenth Infantry, will continue in command of the escort, and furnish all assistance necessary to enable Captain Simpson to perform the duties with which he is charged.

2. The command will reorganize immediately on its return to Camp Floyd, and prepare to march on the 9th instant, rationed for twenty-two days, five-sevenths of the meat-ration on the hoof.

3. The proper staff department will provide the necessary transportation and supplies.

4. Captain Simpson will dispatch a subaltern of his party over the last 100 miles of his new route, with minute instructions to straighten the portion west of Rush Valley, and establish guide-marks upon it.

A detail of one non-commissioned officer and ten dragoons, rationed for twelve days, will escort this officer. This detachment will be immediately prepared, and held ready to march on the arrival of the surveying party.

The depot quartermaster will provide the necessary transportation and material for making stakes, and also for water-troughs at a particular point which Captain Simpson will designate.

By order of Bvt. Brig. Gen. A. S. Johnston.

F. J. PORTER,
Assistant Adjutant General.

August 5, *Camp Floyd.*—Topographical party, with escort under Lieutenant Murry, reached this post this afternoon. It seems that Pete was too late in reaching Lieutenant Murry with the hatchets, the party having got through the difficult portion of Oak Pass before they met. The road through the pass has not been made as practicable for wagons as I had intended, but, in consequence of the General Johnston Pass, 5 miles farther north, being wider and therefore not so liable to obstruction by snow in the winter, and it not lengthening the route a great deal, probably my return route should have come into Rush Valley by this pass. In order to make this connection with my outward route, Lieutenant Smith has received from me, by direction of General Johnston, verbal orders to this effect, and also the following instructions in relation to the shortening the route between Tyler's Springs and William's Spring, and establishing water-troughs at the Marmaduke Spring:

CAMP FLOYD, UTAH, *August* 5, 1859.

SIR: You will to-morrow proceed to Camp No. 32, near William's Spring, on our return-route from Genoa, for the purpose of straightening the road thence to Tyler's Spring, making the Marmaduke, or, as it has been called, the Big Horn Spring, a point of the road. The distance to Marmaduke Spring from Camp No. 32 is believed to be not more than 25 miles, and, by passing through the cañon most convenient to the spring, it is conjectured the distance from it to Tyler's Spring will be about 16 miles.

You will take with you suitable stakes and guide-boards for marking out the road, as also a number of wooden troughs for the purpose of collecting and economizing the water of the Marmaduke Spring for the benefit of emigrants and other travelers. These troughs will be disposed of in the best way for the object in view, and established as firmly as may be required.

You will be escorted by a detachment of one non-commissioned officer and ten dragoons.

Messrs. Reese and Stevenson, who are acquainted with the localities, will accompany you as guides.

Fifteen days' provisions will be carried, and the deputy quartermaster has been directed from headquarters to furnish you with the necessary transportation. He will also furnish you with the troughs, stakes, and tools which will be required.

On accomplishing this duty you will return with all dispatch to this post, and after turning over your escort and quartermaster's property, join the topographical party, which will be encamped at Round Prairie, on the Timpanogos River, *en route* for Fort Leavenworth.

I am, sir, very respectfully, your obedient servant,

J. H. SIMPSON,
Captain Corps Topographical Engineers.

Lieut. J. L. K. SMITH,
Corps Topographical Engineers.

There were also issued to-day the following orders, by which it will be perceived that my instructions of April 26, before given, are so far modified as to cause me to make a reconnaissance for a practicable pass from the Timpanogos Valley, through the Uintah Mountains to Green Valley, and then return to Fort Leavenworth, via Fort Bridger:

HEADQUARTERS DEPARTMENT OF UTAH,
Camp Floyd, Utah, August 5, 1859.

SIR: As, by the time you will be able to leave this camp, the season will be too far advanced to proceed to Fort Leavenworth by the headwaters of the Arkansas, and with safety make any important explorations beyond the Wahsatch range of mountains, the commanding general directs the following modifications of your instructions of the 26th April:

That, as soon as you reorganize your party and train to adapt them to your future duties, you proceed to Round Prairie, on the Timpanogos River, whence, after establishing camp in a suitable position for recruiting your animals, you will ascertain the practicability of opening a wagon-road to Green River, through the valley of the Uintah River; then, discharging those of your guide-party no longer needed, and sending, by the guide, to the commanding general a report of the result of the examinations, you will continue to Fort Leavenworth *via* Fort Bridger, and carry out your former orders.

There is reason to believe that you will, by this examination, connect this portion of the country with the valley of White River (on east branch of Green), ascending which a practicable road can easily be made and connected, if necessary, with the trail of Colonel Loring and Captain Gunnison; but, on account of the imminent danger of being caught in the snows which fall early in the season in the elevated passes of the Rocky Mountains near the Parks, the commanding general will not risk sending you that way.

Moreover, as from the plateau of the South Park an eastern outlet for wagons has not yet been discovered, he thinks it more advisable to attempt, by special explorations up the branches of the South Platte and Arkansas, to unite by a practicable road the eastern with the western slope of the Rocky Mountains, and will suggest this course to the Secretary of War.

I am, sir, very respectfully, your obedient servant,

F. J. PORTER,
Assistant Adjutant General.

Capt. J. H. SIMPSON,
In charge of Surveying Party of Topographical Engineers.

August 6, *Camp Floyd.*—Lieutenant Smith and party left this morning, pursuant to instructions of yesterday. A party of California emigrants, with seven wagons, take, also, my return-route. I have furnished them with an itinerary. Balance of my party engaged in preparations to leave this post, in prosecution of instructions from headquarters given above.

August 7, *Camp Floyd.*—An emigrant train of about thirty wagons passed through to-day, taking my more southern route to California. Supplied them with an itinerary.

August 8, *Camp Floyd.*—Gave Dr. Hobbs, agent of Russell & Co., an itinerary of my inward route. He intends to send immediately over it a thousand head of cattle to California.

Lieutenant Murry, by virtue of the following orders, is relieved from the command of the escort of my party:

[Special Orders No. 67.]

HEADQUARTERS DEPARTMENT OF UTAH,
Camp Floyd, Utah, August 8, 1859.

Second Lieut. Alexander Murry, Tenth Infantry, being an important witness for the United States in a case before the United States district court now in session in Salt Lake City, is relieved from the operation of paragraph 1, Special Orders No. 64, from these headquarters, and, so soon as he turns over the property for which he is responsible, will report to the commanding officer of Camp Floyd.

Captain Simpson will immediately appoint an officer of his party to relieve Lieutenant Murry of his responsibilities.

The senior non-commissioned officer of the escort will report to Captain Simpson for duty.

By order of Bvt. Brig. Gen. A. S. Johnston.

F. J. PORTER,
Assistant Adjutant General.

In accordance with the foregoing orders, Lieutenant Putnam has been assigned the duties of quartermaster and commissary, as follows:

OFFICE TOPOGRAPHICAL ENGINEERS, DEPARTMENT OF UTAH,
Camp Floyd, Utah, August 8, 1859.

SIR: Lieut. Alexander Murry, Tenth Infantry, having been released from the command of the escort which has been directed to accompany the Topographical Engineer party to Fort Leavenworth, and therefore of the duties of acting assistant quartermaster and of acting assistant commissary, you will act in these capacities.

Very respectfully, your obedient servant,

J. H. SIMPSON,
Captain Topographical Engineers.

Lieut. H. S. PUTNAM,
Corps Topographical Engineers.

August 9.—Left Camp Floyd at 12 m., in prosecution of orders of August 5, from headquarters Department of Utah, given above. Party and escort consist, all told, of 54 persons.

Have with us 8 quartermaster's wagons, 1 large spring wagon, 1 light ambulance, and 98 animals. Took the usually traveled road to the bridge over the Jordan; thence through the towns of Lehi, American Fork settlement, Battle Creek settlement, and valley of Timpanogos River to Round Prairie, where, August 10, we encamped. Distance from Camp Floyd 50 miles. For description of these places and the Timpanogos Valley, I extract, as follows, from my report of the route I explored and opened from Camp Floyd to Fort Bridger, under instructions from General Johnston, commanding the Department of Utah, last fall. This report is to be found in Senate Ex. Doc. No. 40, 35th Congress.

"DESCRIPTION OF THE PORTION OF THE ROUTE FROM CAMP FLOYD TO THE MOUTH OF THE TIMPANOGOS RIVER CAÑON, A DISTANCE OF 29.25 MILES.

"The route from Camp Floyd pursues a course east of north for about 9 miles, when it passes over a low ridge, and, gradually turning more eastwardly, leaves Cedar Valley, and gets into the valley of Jordan River, which river it crosses in 5 miles, by a toll-bridge sixty feet long; and thence, continuing its course eastwardly along, and 2 miles from, the foot of Utah Lake, in 2.75 miles reaches Lehi City; thence, turning gradually southwardly, and slightly diverging eastwardly from a parallelism to the shore of Utah Lake, which it leaves to the right at about an average distance of 3.5

miles, and skirting the Wahsatch Mountains on your left, in 3 miles it passes through American Fork settlement (Lake City on the maps); in 3.25 miles more Battle Creek (Pleasant Grove on the map); and in 6.25 miles, reaches the mouth of Timpanogos River Cañon, which it crosses by a good ford. Whole distance from Camp Floyd 29.25 miles.

"The road to this point, except occasionally where irrigating ditches cross it, is excellent, the only hills being those 9 miles out from Camp Floyd. The soil of Cedar Valley, as also that of Utah Valley, which is generally of a yellowish color, is of an areno-argillaceous character, superposed on sand, and the consequence is that, although containing all the elements of fertility, the rains are not of themselves copious and constant enough to keep it sufficiently moist to sustain vegetation. Where the land, therefore, cannot be irrigated, which is the case in Cedar Valley, except in two or three localities of small area, the soil, for agricultural purposes, is utterly worthless. Along the road, however, in Utah Valley, in the neighborhood of the towns named, there are extensive fields, which, on account of the irrigation they receive, are quite productive. The irrigation is made possible by the availability of the mountain streams, Dry Fork, American Fork, and Battle Creek; the waters of which are distributed in acequias or ditches, from which the fertilizing element is carried over the soil in numerous rills. The first two streams are tributary to Lake Utah, and Battle Creek loses itself in the soil before reaching the lake. It is something notable that a large number of the fields have been abandoned from the soil becoming saline by use; and it is quite possible that from this cause a large portion of it will, in time, be rendered worthless. Indeed, while the country in the Territory, as a whole, presents a very insignificant fraction of cultivable soil, that which can be cultivated experience shows is likely to become barren from use.

"The great staple is wheat, of which Mr. Bullock assures me as many as seventy-five bushels have been raised to the acre. This, however, is rare; forty bushels are more common, and generally not more than twenty. Oats and barley do well. Corn does not mature sufficiently, on account of the early frosts of autumn, and therefore but little is planted. Potatoes and garden vegetables generally grow quite luxuriantly. Fruits like the melon, peach, and apricot mature tolerably well, and the apple also grows here, but as yet I have seen none to assure me that they at all equal those which can be raised in the States. It is also to be borne in mind, in the cultivation of the cereals, vegetables, and fruits, that frequent irrigation is necessary; and to this, of course, is superadded all the other labor of tillage, which makes the aggregate of work necessary to make the soil produce to any advantage, excessive. The fields are generally inclosed by mud walls, which not unfrequently give evidences of dilapidation.

"The ordinary tract of land owned and cultivated by a single hand is twenty acres, though larger tracts are owned and cultivated by those who can afford to buy more and command the necessary labor. There is grass along the route, except on the Jordan, and no wood. The fuel which is used by the inhabitants of the towns named is brought from the cañons in the mountains at a very great expense. Forage and fuel, however, are purchasable by the Government.

"Lehi City is a walled town, containing probably 100 houses and 1,000 inhabitants. The houses are of *adobes* (sun-dried bricks), and in some instances of logs. The appearance of the town is rather indifferent, and indicates no great thrift."

"American Fork settlement (Lake City) has some 50 houses and probably some 500 inhabitants. The houses are generally adobe, quite small, and of but one story, all indicating a poor and shiftless population."

"Battle Creek settlement contains probably 60 houses, all small, mean-looking adobe huts, and the population is about 600. A very common mode of building in these towns is to take the earth from the foundation of the building to make the adobes, and thus have one story below and one above ground. The generality of the houses is far below in character what obtains among the poorest of our population in the States. The roofs are generally of mud, and give frequent evidences of tumbling in; and the doors and windows all indicate penury and an inattention to cleanliness."

"Provo is a city in the valley of Lake Utah, about 5 miles south of the Timpanogos Cañon. It derives its name, according to Mr. Bullock, from a Frenchman of that name from Saint Louis, who was the first white man that ever came from Fort Bridger by way of the Timpanogos Valley.* The Timpanogos River has been, therefore, known among the inhabitants as the Provo River, and hence the origin of the name of the town near. It is much better built than the towns I have described. The guide who lives there, says it contains about 400 houses and probably 600 families, 7 to a family, or about 4,200 inhabitants in the whole town; to me rather a large estimate. It, like the other towns I have seen in Utah, is built principally of adobes; the houses, however, being generally small. Each town has a large building, which they call the tabernacle, and which is devoted to religious and secular purposes; the theater, I noticed, being held in one of them. The main street of Provo is probably eight rods wide, the others six. This town, like all the others I have described, is laid out in regular squares. They are all inhabited by farmers, who cultivate the land contiguous to the town, and the yards are filled with the implements of husbandry, stacks of wheat and hay; and in the evening, during harvest, there is to be seen a constant succession of wagons, filled with the produce of the field, and cattle driven in for security. The inhabitants send out their cattle in herds to pasture, the herdsman passing in the morning from one end of the town to the other, and as he does so, sounding his horn as a signal for the owners to turn their stock into the general herd. The charge is about two cents per animal per day."

"FROM THE MOUTH OF TIMPANOGOS CAÑON TO THE TOP OF THE DIVIDE BETWEEN THE TIMPANOGOS AND SILVER CREEK, 31.5 MILES.†

"The Timpanogos River is a splendid dashing mountain-stream of pure water of a width ranging in places from 30 to 100 feet, and generally about 2 feet deep. Large trout are found in it. Its bottom is rocky. Its sources are in the Uintah Mountains, from which it flows for about half its length (which probably is 60 miles) in a westerly direction, and then, breaking through the Wahsatch Mountains, in a southwest direction for the balance of the way (30 miles) into Utah Lake. The road, after crossing the river by ford at the mouth of the cañon, takes up its valley, which is deeply cañoned for about 7 miles above its debouchment into Utah Lake Valley. The rocks on either side, commensurate with the cañon, especially on the south, are magnificent, and, encroaching as they do very nearly on the stream, show themselves in their full proportions. Those on the south side have their escarpments very nearly vertical, while those on the north are girted at their base by terraces of narrow breadth. About 4 miles up the cañon, on its south side, may be seen a beautiful perennial waterfall of from 800 to 1,000 feet in height, and, coming as it does from such an altitude, and apparently fed by nothing, it is an object of a great deal of interest. I have called it on the map Beautiful Cascade. Through this cañon, and 5 miles farther, say for a distance of 12 miles from its mouth, there is at present a road which the people of the Territory constructed last spring and summer. Previous to the opening of this road, persons could pass only upon horseback along an Indian trail; the rocky promontories or points of the confining walls, as well as the narrowness of the cañon, effectually obstructing wheel-carriages. A company of citizens, however, have, by dint of great labor, cut through these promontories, made deep excavations along the steep, and in many instances rocky, side-hills, and have built up revetted embankments; the consequence of which is they have an excellent mountain-road, and one that does them a great deal of credit. The width of the roadway, however, in many places and for considerable distances, is not sufficient for teams to pass each other, and the turns are sometimes so short that heavy six-yoke ox-teams are liable, except the driver use the greatest care, to capsize into the stream below. The drainage of the mountain streams and rills from the upper side of the road is defective, and the consequence is that pools of water have been allowed to collect in the road, and the road at these places made boggy. With these defects obviated the road would be as good as is to be found anywhere. It was constructed by the inhabitants to open the communication to Round Prairie (an expansion of Timpanogos Valley, 14 miles above the mouth of the cañon), and to enable the people of Provo to carry away the wood found along the river and in the side cañons. About 1 mile above the mouth of the cañon the road crosses the Timpanogos by an excellent bridge, 60 feet long. The tolls upon the road are here collected, and, as it is of interest to know the rates, I here insert a notice which I saw stuck up on the post of the toll-gate:

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* The name of this person was probably Pro-vost (pronounced Provo), and is doubtless the same referred to in Mr. Anderson's letter, inserted in note (E) of Introduction.

† For an interesting account of the Timpanogos River Valley, Weber River Valley, and White River Valley, see Captain Beckwith's report of his reconnaissance between Great Salt Lake City and Green River, in the spring of 1854. (Pacific Railroad Reports, vol. ii.)

Rates of toll on the Provo Cañon road.

For one cord of wood or timber hauled out	$1 00
For one pair of horses, mules, and carriage	50
For one horse, mule, and rider	10
Cattle, horses, or mules, driven up or down, for each head	05
Sheep and hogs	03
For each load of brick or hay	1 00

The above is a correct list of rates of toll as fixed by the county court. And all persons are hereby notified and instructed that no one will be permitted to travel the road without an order from Bishop E. H. Blackburn, and the gatekeeper will take due notice of the above instructions, and govern himself accordingly.

Done by order of the county court of Utah County:

E. H. BLACKBURN,
General Agent.

"In this connection I think it proper to say that no permission was asked by me to go through the cañon, and no objections were made; and this I believe has been the experience of all the Government and contractor's trains which have passed over the route.

"To resume my account of the route. Four miles from the mouth of the cañon is the first sufficiently wide place for a small command to encamp, and here will be found plenty of grass. Two miles farther is the first sufficiently wide place for ox-teams to corral, and grass also exists here in abundance. Indeed, from this point as far as the road extends along the Timpanogos, a distance of 23 miles, at short distances can be found most excellent camping-places for the largest commands and trains. The river is well timbered from the mouth of the cañon up, and there is every other requisite needed.

"As I have before remarked, the turnpike extends from the mouth of the cañon for a distance of 12 miles. Thence the route continues along the Timpanogos, crossing it about a mile above Wall's ranch, and through Round Prairie for a distance of 10 miles, when it enters another cañon, or, rather, narrow valley, 4 miles long, where the river is in places obstructed for about 3 miles by beaver-dams and where the road for a few hundred yards is rather soft. This cañon gone through and the line crossed again, the route leaves the main Timpanogos and, passing along a small tributary, in 4.5 miles commences going up the divide between the Timpanogos and Silver Creek, and in a distance of 1.5 miles, with a pretty fair grade and on rather a stony slope, reaches the summit. The principal timber on the creek is the oak, cottonwood, box-elder, sugar-maple, birch, and willow. Pine and the fir-tree are to be seen on the mountains. Currants, red and black; the sweet sarvisberry, and a blue berry like the small winter grape, and which the Mormons call the mountain grape, are found in considerable quantities in the valley.

"In Round Prairie, near where Rattlesnake Creek debouches from the mountains, on the north side of the valley, are to be seen a number of hot springs, the highest point the thermometer indicating in any one of them being 109°.50. These springs, which are of great depth, well up from the surface, and, running over, deposit a residuum or tufa, which accumulates about their mouths and forms tumuli, in one instance of about 60 feet in height and 200 feet in diameter at base. These tumuli are hemispherical in some instances, and in others conical, and after attaining a certain height the water ceases to flow, and the walls begin to disintegrate and tumble down, and are eventually lost in the general level of the country.

"For several miles the substratum, for a depth in some places of 60 feet, as far as could be discovered, was composed entirely of this calcareous rock, and there is no doubt it is entirely due to an origin of the same sort. Rattlesnakes abound about these springs, and in a warm summer's day you cannot tread near some of them without hearing their sharp rattle. Traces of coal are to be seen in the lower cañon, near its mouth, and the guide informs me that he has picked up specimens in the creek, which, on that account, has been called Coal Creek. The Timpanogos Valley is remarkably well watered, and the traveler will be greatly pleased, particularly on a hot summer's day, with the many cold, gushing, pure streams which he will cross, all flowing into the Timpanogos.

"The grass, particularly in Round Prairie, where there is a great deal of meadow land, is abundant, and I know no place where stock could be better fed, sheltered, and watered during summer and winter. Already have stock-grazers gone into this valley and secured a considerable quantity of hay for the winter. The soil is, a great deal of it, of excellent character, and, as it is capable of being easily irrigated, I doubt not it will prove very productive."

I would add to the foregoing that Mr. Wall, who has a ranch at the lower portion of Round Prairie, informs me that, on the night of the 7th August last, a frost killed all the vines, corn, and vegetables he had planted as an experiment to see if they would mature in this valley. The spring wheat and oats were not injured, though the former is backward. He is confident that fall wheat, oats, barley, and rye will mature. Has 1,000 head of sheep and 2,000 head of cattle grazing in the valley. It is a singular circumstance that, higher up the valley, in Round Prairie, at Heber City, the frost has not proved near so destructive, it having as yet done little or no damage. The elevation of Round Prairie above the sea is 5,571 feet. Longitude, 111° 25′ 56″; latitude, 40° 29′ 25″.

August 12, *Camp on Torbert's Creek, Round Prairie.*—Elevation above the sea, 5,786 feet. Thermometer at 5.30 a. m., 43°. Having established my main camp at this point, I leave this morning to examine pass over Uinta range into Green River Valley, agreeably to orders of General Johnston of August 5th. Take with me one of my assistants, Mr. Henry Engelmann, (geologist and meteorologist,) ten dragoons, Mr. James Gammell, as guide, Ute Pete, Clark, and Dougherty, in all sixteen persons, with three pack-mules. After being engaged nine days in this reconnaissance, I returned to the main camp August 19, and reported the next day, as follows, to General Johnston:

"CAMP, TORBERT CREEK, ROUND PRAIRIE,
TIMPÁNOGOS VALLEY, UTAH TERRITORY, *August* 20, 1859.

"SIR: Agreeably to the orders of the commanding general of the 5th instant, I left Camp Floyd with my party on the 9th, reorganized for its return to the States, and prepared to make, on its arrival at this camp, the examination required in said orders, of the country intervening this and the Uinta Valley for the ascertainment of the practicability of a wagon-road hence to Green River.

"I arrived here on the 11th; started on the exploration referred to the next day, and returned last evening. My course was about northeast 4.5 miles to mouth of Coal Creek Cañon; thence, magnetically south 65° east, up the cañon of Coal Creek about twelve miles, to summit of divide of the Uinta Mountains; elevation above the sea, 9,680 feet; thence down the valley of Potts's Fork,* generally north 70° east, 24 miles, to its junction with Du Chesne's Fork of the Uinta River; elevation above the sea, 6,814 feet; and thence, generally south 70° east, down the valley of the Du Chesne 39 miles, to its junction with the Uinta River. Longitude, 110° 20′ 33″; latitude, 40° 09′ 50″. Elevation above the sea, 5,345 feet. Whole distance from mouth of Coal Creek Cañon to the Uinta River, 75 miles. Here my examination ended, on account of the dragoon-horses of the escort, all except one, giving out, and, of necessity, having been left behind, 10 miles. Their crippled condition was produced by the extraordinarily rough, steep, and stony character of the reconnaissance from Round Prairie over the Uinta Mountains as far as the Du Chesne. It is gratifying to report that I found the pass of the Uinta range, by the way of Coal Creek Cañon and Potts's Fork of the Du Chesne, the route I explored, a most excellent one. The grade from Round Prairie to the summit of the Uinta range is quite good, and thence down to the Du Chesne's Fork and to the Uinta still better. The route, however, is at present far from being practicable for wagons, and not even is it practicable for pack-mules without the very greatest tax upon man and animals; the most difficult and laborious reconnaissance I ever have made being from Round Prairie to the Fork of the Du Chesne, rendered so by willow, aspen, and fir thickets, and by steep and rocky precipices and ridges. It is not to be wondered that Mr. Gammell, the guide, in his previous examination of the route, was obliged to leave his horse on account of its crippled condition, and came near losing another.

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* This fork is a branch of Du Chesne's Fork, and I have called it after the lamented Lieut. E. Kane Potts, Seventh Infantry, who died at Camp Floyd April 23, 1859. He was a bright young officer, and greatly beloved by his brother officers and the soldiers.

"The principal work required for the passage of wagons will be the removal of the fallen and standing timber, and willows in the bottom of Coal Creek Cañon, from its mouth to within about a couple of miles of the summit of the pass, say for about 9 miles; the removal of the willows in Potts's Fork, from about 3 miles from the summit all the way down, about 21 miles, to the fork of the Du Chesne, and the causewaying of the miry places in the bottom of this creek, caused principally by beaver-dams. In the valley of the Du Chesne there will be required about 6 miles of not very heavy cutting through cottonwood and brush, and some grading, to pass over several tolerably deep gullies.

"My examination of Coal Creek Cañon and Valley extended to the exploration of three parallel routes which presented themselves, to wit, the swale or vale under the mountain ridge to the north side of the creek; the swale under the mountain ridge to the south side of the creek; and the bottom of the creek or cañon itself. The last, or that in the bottom of the creek, will require more work than the swale on the south side; but when done will make the best grade and road. The next best route, and requiring, perhaps, the least work, is the swale on the south side of the creek.

"My examination also extended to the three branches or cañons from the summit of the Uinta Pass, leading into the cañon of Potts's Fork. The best are the middle and most northern; either of which may be taken.

"I have already stated that my exploration, of necessity, stopped short of Green River, having terminated at the junction of the Du Chesne's Fork with the Uinta River. I consider, however, the reconnaissance conclusive as to the ascertainment of a pass from the valley of the Timpanogos to the Uinta River; and from the plateau or table character of the country, thence east to Green River, which could be very well seen, the practicability of the valley of the Uinta where I struck it, and the assurance of the guide, whose report of the route, as far as I have gone, except as to distance, I have found correct in every particular, that the valley of the Uinta grew still wider and better for a road in proportion as it approached Green River, I have not the slightest doubt that a good wagon road can be made all the way from Round Prairie to Green River, and that the principal work required will be that which I have already specified.

"I consider the discovery of this pass, in connection with the Timpanogos route through the Wahsatch range, a most fortunate one, and doubt not it will end in the formation of a wagon-route all the way through the Rocky Mountains, which will greatly ameliorate the present traveled routes, and be of great service in the extension of my lately explored route from California eastward by way of Denver City to the States.

"I am preparing to leave for Fort Leavenworth to-morrow morning.

"I am, major, very respectfully, your obedient servant,

"J. H. SIMPSON,
"*Captain Corps Topographical Engineers.*

"Major F. J. PORTER,
"*Assistant Adjutant General, Camp Floyd, Utah Territory.*"

would add to the foregoing that the route, as far as the Uinta River, is quite well wooded: on Coal Creek Cañon with cottonwoods and fir trees; on Potts' Creek with the fir, and on the Du Chesne with the cottonwood and dwarf cedar. I would also remark that the valley of the Du Chesne, which varies from a quarter to two miles wide, is a great deal of it cultivable, and as it lies well for irrigation is well watered, and probably warm enough for crops. I doubt not when it shall have been made accessible by a good wagon-road it will rapidly fill up with population. The valley of the Uinta, Mr. Gammell represents as also being very fine, all the way to Green River, being covered with groves of large cottonwood, beautiful grass, and so lying as to be easily irrigated. It is, besides, accounted as one of the warmest valleys in the Territory. He says it is from one to ten miles wide. Both the Du Chesne Fork and the Uinta River, where they meet, are about 50 feet wide, and from one to three feet deep. The former is said to contain trout and white-fish, the white-fish weighing from 10 to 25 pounds. The valleys of these rivers are deeply seated between inclosing heights, varying from 200 to 500 feet. The formation of the rocks is like that of White Clay Creek, whitish sandstones alternating with sandstone shales.

Besides the value of the discovery of this pass, in connection with the extension of my routes, and the establishment of the magnetic telegraph from California directly eastward, through the Rocky Mountains, via Denver City, or some other Pike's Peak country town, to the States, and thus shortening the present postal route from Camp Floyd to Saint Joseph from 60 to 100 miles, the construction of the road will be of great value in opening an avenue of trade between the Mormon settlements and the Pike's Peak country, by which the produce of the former may be conveyed to the latter, much to the benefit of the miners.

It will be also noticed that a link of about 100 miles, between the mouth of Du Chesne's Fork and Gunnison's route, along the Grand River, which the guide says is practicable, will open a route to the headwaters of the Arkansas, and to Santa Fé from Camp Floyd; which will be much shorter, and, doubtless, in other respects much preferable to the present roundabout route, by the way of Salt Creek and the Sevier Valley.

Pete says the Indians call the Uinta the Pow-up. He does not know its meaning. The Du Chesne, which they call the Kopes-se-parge, or Smoky Fork, according to them, is a tributary of the Ke-air-re-gan, which comes from the northeast into the Du Chesne, about 13 miles above its junction with the Uinta, and carries its name all the way to the Uinta. The two streams, at their junction, are about the same in size. The bull-berry is very abundant in the valley of the Du Chesne, and as the bear is very fond of them, the signs of these animals are very fresh and frequent. I have noticed also the prairie dog; the location being the most western limit of these animals I have observed. The branch of the Uinta, called on the maps Lake Fork, the Indians call Whi-tum-bitch, or Yellow Rock Creek. I have inquired of Pete the meaning of Uinta. He thinks it may possibly have come from the word U-umph, which means, a sort of pine common to the Uinta range.

On my return to main camp, August 19, found Lieutenants Murry and Smith had just arrived and joined the party. The former has joined the expedition again, agreeably to the following orders:

[Special Orders No. 72.]

HEADQUARTERS DEPARTMENT OF UTAH,
Camp Floyd, Utah, August 17, 1859.

Second Lieut. Alexander Murry, Tenth Infantry, will join and take command of the escort to the exploring party under Captain Simpson, Topographical Engineers.

The depot quartermaster will provide the necessary transportation for Lieutenant Murry and Lieut. J. L. Kirby Smith, Topographical Engineers, and his party, now at this post.

By order of Bvt. Brig. Gen. A. S. Johnston:

F. J. PORTER,
Assistant Adjutant-General.

August 20, *Camp, Torbert's Creek, Round Prairie.*—Thermometer at 7 a. m., 65°. I have received, to-day, from Lieutenant Smith the following report, in fulfillment of my instructions, given to him at Camp Floyd, August 5:

CAMP ROUND PRAIRIE, UTAH, *August* 20, 1859.

CAPTAIN: I have the honor to submit the following report of the fulfillment of your instructions to me, dated Camp Floyd, Utah Territory, August 5, 1859, a copy of which is herewith inclosed. In obedience to those instructions I left Camp Floyd on the 6th instant, reaching Meadow Creek, in Rush Valley, the same evening. I was provided with four large troughs, destined to collect the water of Marmaduke Spring, and with the tools and material for erecting guide-boards to mark the new and direct trail. On the morning of the 7th I moved west, through Johnston's Pass, to its west foot. Here, as directed by you, I left the beaten road, and, turning to the left, moved up a ravine which leads into Johnston's Pass from the south, and furnishes a path thence into the ravine of Brewer's Spring and Creek. The distance by the odometer from the point where I left Johnston's Pass to the point where I struck the ravine of Brewer's Creek is eight miles and four-tenths. The trail over this portion of the route is tolerably direct, but it is somewhat hilly in its southern half, crossing a number of ravines, which presented themselves at right angles and could not be turned without too great a detour. From the point where I struck the ravine of Brewer's Creek I moved up that ravine to your recent return-trail from California, a distance of three miles. I encamped near here on the 7th; Mr. Reese, the guide, whom I had sent forward in the morning to examine a supposed pass through the Champlin Mountains, returned at night and reported it impracticable for wagons.

On the 8th I proceeded by your trail to the point three miles from William's Spring, alluded to in your letter of instructions as camp "No. 32." On the morning of the 9th three mules from one of the teams were found to be missing, and the day was passed in an unsuccessful attempt to find them. Leaving Stephenson, one of the guides, with my mule, to continue the search for the lost animals, I moved on at nightfall for Marmaduke or Big Horn Spring. I followed your trail for about a mile and a half, and then diverged from it to the right. Our road now lay through the range of hills in which Indian Spring is situated, and was necessarily somewhat tortuous, though its general direction was nearly correct. I halted when the moon set (about midnight), and continued the march on the morning of the 10th. We soon emerged from the hills and moved west of south across the valley west of Good Indian Spring, reaching Marmaduke Spring about 3 p. m. We found here, by digging, sufficient water for our immediate wants, but the holes soon ceased to fill up, and the water gave out entirely before night. It seemed evident to me, on examination of the locality, that the supposed spring at this point was nothing more than a reservoir of rain-water, retained in a natural basin of rocks and protected from evaporation by the sand which fills the basin. I found the distance from the camp near William's Spring to this point to be 24.4 miles, verifying nearly your previous estimate.

On the 11th I proceeded to Tyler's Spring by the most direct route possible, finding a good pass through the mountain west of Big Horn Spring. I improved Tyler's Spring by digging several new reservoirs there, and on the 12th commenced my return. I adopted a pass through the mountain west of Big Horn Spring, a little north of the pass I used going out, and preferable to it in some respects. Being forced to abandon Big Horn Spring as a camping or watering place, it seemed necessary to make the Good Indian Spring a point of the route, and I decided to carry the troughs thither. I sent Mr. Reese forward, accordingly, to ascertain the best route to Indian Spring. He found a very direct eligible route thither, and we reached that point on the morning of the 13th instant. The distance from Tyler's Spring to Good Indian Spring, by the trail I followed, is 35 miles. I remained at the latter spring during the 13th and 14th, placing the troughs and perfecting their arrangement as far as possible. On the night of the 14th Stephenson arrived with the lost mules.

I left Good Indian Spring on the 15th, following your trail to within two and a half miles of Camp No. 32, near William's Spring. Here I diverged to the right, striking your trail again about two miles this side of the camp near William's Spring, cutting off between one and two miles of the distance from Indian Spring to Prince's Creek, and reducing that distance to 16 miles. I adopted no further changes in the route I pursued going out, from Prince's Creek to Camp Floyd, which post I reached on the 17th instant. Wherever the trail I adopted intersected or diverged from any other wagon-trail, the route to Carson's Valley was indicated by a guide-board, and if the other fork was a trail which I had abandoned, it was ditched across and further obstructed by sage or cedar brush.

A party of emigrants, with six wagons, overtook me going out, near William's Spring, and followed my outward trail to Tyler's Spring. Returning I met upon the proper trail five other parties, having in all, I should think, about thirty wagons, and one herd of cattle numbering a thousand head. I gave them all such information as they required about the route ahead of them, and have no doubt they followed the trail I recommended to Tyler's Spring, making that the most marked and best beaten road.

In compliance with your instructions I have added to your itinerary of the route from Genoa to Tyler's Spring my notes of the route from that point to Camp Floyd.

I am, sir, very respectfully, your obedient servant,

J. L. KIRBY SMITH,
Second Lieutenant Topographical Engineers.

Capt. J. H. SIMPSON,
Corps of Topographical Engineers.

The day spent in reporting by letter to General Johnston result of expedition to Uinta Valley (report given above), and preparing for return to Fort Leavenworth, via Fort Bridger.

August 21, *Camp Torbert's Creek, Round Prairie.*—Whole party decamped this morning, on its return to the States. Course up the valley of the Timpanogos. Having reached the point where the road leaves the main branch of the Timpanogos, we encamped. Journey 14 miles. Since my exploration of this valley last fall a small settlement called Heber City, containing ten families, has sprung up in Round Prairie. The frost, two weeks since, nipped the potatoes here, but did not permanently injure them; they are still growing finely, and already some are eatable and have been sold in our camp.

Lieutenant Swaine and family arrived, on their way to Camp Floyd, this afternoon, and have encamped near us.

August 22, *Camp, bend of Timpanogos River.*—Longitude, 111° 26′ 03″; latitude, 40° 36′ 15″; thermometer at 8.30 a. m., 64°. Wishing to see if my route to Fort Bridger from Camp Floyd, via Timpanogos, Weber, and White Clay Creek Valleys, opened last fall, can be shortened, I have directed Lieutenant Murry to proceed with the main party and wagon-train, independently of me, to Fort Bridger, by that route, and I take a party of seven persons, including my assistant, Mr. Englemann, with two pack-animals, for the purpose of exploring a more direct route by the way of Kamas Prairie, the east fork of the Weber and one of its tributaries, across to the head of White Clay Creek, or Bear River.

I reached Fort Bridger with my party August 26, and find that Lieutenant Murry with the train and main party had reached there the day before. As my report to

General Johnston of the results of my side reconnaissance is sufficiently explicit, I insert an extract from it below instead of the journal. I refer the reader to my published report, before adverted to, to be found in Senate Executive Document No. 40, Thirty-fifth Congress, Second session, for a detailed account of my route of last fall, pursued by Lieutenant Murry, as also of Kamas Prairie, and other portions of country contiguous. I met Lieutenant-Colonel Chapman, Fifth Infantry, with a battalion of recruits and train of wagons, on my route between the Muddy and Sulphur Creeks, and he expressed himself as being very much pleased, as far as he had gone on it from Fort Bridger.

FORT BRIDGER, UTAH,
August 27, 1859.

MAJOR: I have the honor to report that, wishing to improve if possible my route of last fall from Camp Floyd to Fort Bridger, by avoiding the worst portion of it, White Clay Creek, in whole or in part, I left the main portion of my party *en route*, in Timpanogos Valley, for Fort Bridger, August 22, and with an escort of four dragoons, three civil employés, and a couple of guides, who professed, each, to know different portions of the country, proceeded to make the exploration requisite for the purpose. Our provisions and necessary equipage were carried on two pack-mules.

I found a feasible wagon-route as follows:

Leave my old route at a point in Timpanogos Valley, in sight of where the road commences to ascend the steep portion of the divide between the Timpanogos and Silver Creeks, that is, about a mile below the foot of the ascent; from this point pass up on the top of a low spur, with good and regular grade, to near summit; and thence, by taking advantage of the swales or vales of the divide, pass along their sides to the summit of the divide, 2.5 miles from the branch of the Timpanogos you have left; elevation above the sea, 6,955 feet; thence taking down a ravine of good grade (general direction east), which widens gradually into a fine, wide vale, full of grass, in 3 miles you reach Kamas Prairie, 6,244 feet above the sea; thence in a course very nearly direct to the mouth of the cañon of the east branch of Weber (bearing slightly to the right of it), in about 7.25 miles, you cross Kamas Prairie over very good ground, and reach the east fork of Weber, which you ford; thence pass up the cañon of this fork of Weber 8.5 miles, about a mile of it through thick aspen timber, the balance, principally in the bottom, covered with willows, which, however, are not large; thence you leave the Weber and turn to the left up a rather narrow cañon, which I call Clarke's Cañon, after Captain Clarke of the Subsistence Department, where some cutting would be necessary through aspen and willows thickets, and two or three small points of hills should be taken off with the pick and shovel; 4.5 miles up this cañon, with tolerable grade, brings you to the summit of the pass of the high range between the Weber and the heads of White Clay Creek; elevation of summit above the sea, 8,953 feet; thence, turning gradually to the right, skirt closely for 9.25 miles the high ridge of the mountain range, keeping just below it and crossing through aspen thickets, a number of the heads of the tributaries of White Clay Creek, you are brought over a very steeply-rolling and rich country to the main branch of White Clay Creek; thence, in 3.5 miles, down this main branch, with good grade, you connect at the lower end of the upper cañon of White Clay Creek with my wagon-road of last fall. This is one connection. Another would be, not to go down entirely to the old road, but, passing down the branch only about a mile, to cross it and, turning by a heavy side-cut for about 100 yards up a high ridge on the right, strike over so as to join the old road about 8 or 9 miles above the point of junction with old road above mentioned. The first connection would shorten the present Timpanogos route about 7 miles; the second about 12.

The first route could be opened by any command equal to a company in twenty days between Fort Bridger and Camp Floyd. The second would require a day or two longer.

In respect to the character of the route it would be shorter as stated than my old route, and the bottom of the Weber, though moist and principally covered with willows, would furnish a drier road than White Clay Creek bottom; but the objections to it are that, though the grass along it might prove sufficient, yet for 9 miles along the north side of the range, between the Weber and White Clay Creek, the road would be exceedingly hilly, and, as the soil is very rich, would cut up considerably until it could become packed by use. Another objection is that, on this high mountain range, the road could not be used early in the spring or late in the fall, on account of snow.

Taking the advantages and disadvantages together, and the fact that during dry weather my road of last fall down the valley of White Clay Creek is as good a one in every respect, almost, as needs be, as all who will travel over it at such times, I think, will testify; and that when the country is wet the newly proposed route would be almost, if not quite, as exceptionable on that account as the old, and the trains would in preference take the old Echo Cañon route as far as the Weber, and then turn up the Weber to join my Timpanogos route; it is scarcely, I think, expedient that the route I have just explored should be opened, at least by the troops.

Lieutenant Murry and Lieutanant Putnam report that they had not the slightest difficulty in getting the train of my party over my White Clay Creek route, and the fact that the traveling time from Camp Floyd to Fort Bridger was only 8.5 days, and that in every instance they got into camp before 6 in the afternoon, are evidences in favor of the route.

There is a slough, however, about one-fourth of a mile to the east of the main branch of Bear River which should be corduroyed or causewayed with logs without delay. Ten men, with two wagons and sharp axes, might do it on the ground in two days. This done, in ordinary dry weather the road will be a very good one, and by some considerable outlay in causewaying in places in the bottom of White Clay Creek it could be made a good road at all times.

I regret to say that in my reconnaissance I lost a dragoon horse and one mule, which could not be turned back to camp, in a thick aspen thicket after dark. Every exertion was made to recover them, I stopping a day for the purpose, but with no avail. The guides have promised, if possible, on their return to find them, and one of them to take them into Camp Floyd, as well as a pack-saddle I was obliged to leave. The names of these guides are Charles E. Colton and Hiram Oakes. They live at Heber City in Round Prairie, and either of them, if called upon, would show the route I have described.

It might be best, instead of taking up the bottom of the Clarke's Cañon from the

Weber to the Uinta Divide, to run the road up, and on top of, the ridge on either side of the cañon, as might be found expedient.

I expect to leave for Fort Leavenworth Monday morning, the 29th instant.

I am, major, very respectfully, your obedient servant,

J. H. SIMPSON,
Captain Corps Topographical Engineers.

Major F. J. PORTER,
Assistant Adjutant-General, Camp Floyd, Utah.

August 27, *Fort Bridger.*—Longitude, 110° 23′ 47″; latitude, 41° 20′ 23″; altitude above the sea, 6,656 feet; thermometer at 5.30 a. m., 37°.5. Replenishing supplies and preparing for a move on the 29th.

August 28, *Fort Bridger.*—Lieutenant-Colonel Canby, the commanding officer of this post, informs me that oats, spring wheat, barley, potatoes, and turnips, grow well in this locality; beets tolerably well. The sutler, Judge Carter, has a farm at Camp Supply, 12 miles higher up, on Smith's Creek, where agriculture does better than at this point, owing, as it is supposed, to the winds in that direction keeping off the frost. The season this summer, however, has been much better than usual, more rain having fallen than was ever known before.

Colonel Canby has had a saw-mill put up by the soldiers, made up of the parts of two mills, which saws 4,000 feet per day, and the cost per 1,000 feet does not exceed $10.

To-day a train of about 100 hand-carts passed the fort, drawn by Mormon men and women, all having a sort of harness suitable for the work. I did not see it, but the officers who did pronounced it a most lamentable sight.

August 29, *Fort Bridger.*—My party left this morning, in prosecution of its march eastward to Leavenworth, via South Pass. Arrived at Fort Laramie September 17, Fort Kearney October 3, and Fort Leavenworth October 15. As this route has been so frequently reported on by others it will be unnecessary for me to say anything in relation to it.

I think it proper, however, to record the singular meteorological phenomenon, which I witnessed on the Big Sandy, on the night of the 1st of September, and I do it by inserting the letter I addressed to Professor Henry, Secretary of the Smithsonian Institution, on the subject.

"CAMP NO. 33, NORTH FORK OF PLATTE RIVER,
"SIX HUNDRED AND NINETY-TWO MILES FROM CAMP FLOYD,
"EN ROUTE TO FORT LEAVENWORTH, *September* 23, 1859.

"DEAR SIR: Although keeping a meteorological diary in my reconnaissance, which may eventually be brought to your notice, yet it has occurred to me that the remarkable phenomenon I witnessed on the night of the 1st of September instant, on the Big Sandy, a branch of Green River, in latitude about 42° north, and longitude 109° 50′ west of Greenwich, ought to be brought to your attention at once, so that it may be used in any comparison you might wish to make of like phenomenon which might have been noticed before or at the same period in other portions of the globe.

"I had retired to bed and gone to sleep, when waking up and perceiving it quite light and no one stirring in camp, I began to think that the cooks had not been called by the guard, and that we were likely to have a late start for the day. Taking up my watch, which was lying on the table near me, I could distinctly read on its metallic face the time of the night, and, to my surprise, found it was only 11 o'clock. Before I went to bed, about 9 o'clock, the moon had set, and I recollected that it was with some difficulty I had been able to discern the figures of a couple of my assistants who were taking astronomical observations, though they were not far from me. These facts were curious, and I leaped to the front of my tent to clear up the matter. As soon as I looked out the anomaly was explained. About two-thirds of the whole southern celestial concave was one sheet of beautiful roseate light.

"For a while the light continued in a state of repose, the most concentrated portion forming a belt, and extending from a point on the horizon a few degrees north of east (about 10) clear across the heavens to a point on the horizon about due west. From this belt the light, with its roseate hue, was diffused southwardly all over the heavens, with marked distinctness, down to the arc of a circle, the angle of whose plane with the horizon was about 10 degrees.

"For a period, as stated, the phase of the phenomenon appeared constant; it then changed gradually, alternately varying to a less or greater intensity, the rosy light still remaining diffused. At length, however, the light assumed a more intense form and shot up in whitish coruscations from the base or lower limit of the illuminated portion to the apex or crown, which was about 20° to the south of the zenith; the appearance of the concave all this while being that of an illuminated globe divided into an innumerable number of meridians, and the vanishing-point or apparent pole the apex referred to.

"At the time of the phenomenon, I observed the magnetic needle, but could not perceive that it was sensibly affected by it. It being, however, only a pocket one, it could not, of course, be capable of expressing any but very large perturbations.

"The phenomenon was so extraordinary and beautiful that I called up my assistants to observe it. It then appeared that one of them (Mr. Jagiello) had observed it at 10 o'clock, and, as it disappeared about 12, it must have lasted about 2 hours.

"The aurora borealis, as seen north of the zenith, is a phenomenon of frequent occurrence; but a southern illumination, like that I have described, I have never before seen, and I leave it to those who are familiar with such subjects to explain the cause.*

"I am, very respectfully, your obedient servant,

"J. H. Simpson,
"*Captain Corps Topographical Engineers.*

"Professor Joseph Henry, LL. D.,
"*Secretary of Smithsonian Institution, Washington, D. C.*"

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* I have received the following reply to this letter from Professor Henry:

"Smithsonian Institution, Washington, D. C., *October* 25, 1859.

"Dear Sir: I write to thank you for your very interesting letter relative to the aurora borealis of the 1st of September, which is important, particularly on account of its locality and the precision with which you have described the phenomena.

"The information of the corona in your locality is an interesting fact, and, in connection with the other observations of a similar kind in other places, will furnish the data for settling some points of importance in the theory of this

I cannot, however, conclude my report without expressing my acknowledgments to Maj. Hannibal Day, Second Regiment Infantry, the officer commanding at Fort Laramie, for his very courteous and acceptable treatment of the party while we were encamped near his post. It was in the cemetery of this post we buried Mr. Walter Lowry, the gentleman who had joined us at Genoa (see journal of June 20 and 24), and who accompanied us, with the expectation that the trip would be of benefit to his health, and that he would be enabled to reach his friends in Philadelphia. His disease was of a pulmonary character, and although at the outset of the journey he rallied a little and was enabled to ride for an hour or two on horseback, before he reached Camp Floyd he found himself incapable of this, and was necessitated to confine himself to the carriage, to which he had eventually to be carried bodily. Major Day kindly permitted him to be cared for at the hospital, and Assistant Surgeon Johns rendered him all the medical aid he required. He survived, however, only one day after he reached the post. It is a pleasure to me to record the disinterested kindness of the sutlers of the post, Messrs. Ward and Fitzhugh, in disposing of the effects of the deceased, forwarding the proceeds to his friends, and placing, at my request, a memorial of him upon his grave. The deceased had for several years been connected with the papers in San Francisco, as commercial editor, and was highly esteemed by those who knew him.

On the 19th October, having shipped at Fort Leavenworth for Washington our instruments, geological, botanical, and other specimens, illustrative of the country we had explored, and discharged all the party except my assistants I left for the purpose of repairing to the seat of Government and reporting to the Adjutant-General.

All of which is very respectfully submitted.

J. H. Simpson,
Captain Corps of Topographical Engineers, U. S. Army.

To Col. J. J. Abert,
Chief Corps Topographical Engineers.

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meteor. I presume the magnetic needle which you observed was a short one, supported on a point, and, therefore, no action, except one of very unusual intensity, could be observed. The needles generally used for this purpose are those suspended by a single fiber of silk, and the deviations observed by the reflection of the divisions of a scale into the axis of a telescope. Theoretically, however, the action of the aurora on the needle ought to be very uncertain, since if the aurora be an electric discharge to the earth, no action on the needle could be anticipated when this discharge took place with equal intensity east and west of the needle. If, however, the action was much more powerful to the west than to the east, a slight deviation in one direction or the other ought to be observed.

"We are very anxious to obtain the result of your meteorological observations. They will not only be interesting in themselves when published as a part of your report, but particularly so to us, in studying the phenomena of the progress of atmospheric disturbances. You are almost in the very region of the great laboratory of American storms, and every observation you may record in regard to the weather may prove of special interest.

"Very respectfully, yours,

"Joseph Henry.

"To Capt. J. H. Simpson."

[I would remark, in relation to the above letter, in respect to the importance of having a proper needle for the discovery of slight perturbations from terrestrial or other causes, that we had with us a unifilar magnetometer, the same which Dr. Kane had on his last Arctic expedition, and which could be converted into a declinometer; but on account of the unseasonable and unexpected occurrence of the phenomena referred to, and although we observed results from it on other occasions, which are given in my report, we did not make use of it on this.]

APPENDIXES A, B, AND C.

ITINERARIES OF WAGON-ROUTES.

APPENDIX A.

ITINERARY OF THE MORE NORTHERN OR OUTWARD WAGON-ROUTE FROM CAMP FLOYD, UTAH, TO GENOA, IN CARSON VALLEY.

Localities.	Captain Simpson's camps.	Intermediate distances.	Total miles from Camp Floyd.	Fuel.	Water.	Grass.
Meadow Creek, mail station	C.	18.2	18.2	G. W.	W.	G.
General Johnston's Pass, Guyot range, three-fourths of a mile below summit, on west side; springs to right and left of road; but little water, and probably not constant	C.	9.9	28.1	W.	W.	G.
Simpson Spring, mail station: Water not abundant; fill water-kegs for crossing the desert, which commences here	C.	16.2	44.3	G. W.	W.	G.
Devil's Hole: Water quite brackish; animals can only be watered by bucket	......	43.1	87.4	......	......	......
Fish Spring, mail station: Water brackish, but palatable when cool; grass saline	C.	5.4	92.8	G. W.	W.	G.
Warm Spring	......	3.4	96.2	G. W.	W.	G.
Sulphur Spring: Water in abundance, and palatable; grass also abundant	C.	28.8	125.5	Wil. and S.	W.	G.
Fine Spring, Pleasant Valley, Goshoot range, mail station	C.	13.4	138.4	W.	W.	G.
East side of Antelope Valley	C.	12.5	150.9	W.	W.	G.
Spring Valley: Best grass on west bench of valley	C.	19	169.9	G. W.	W.	G.
Mouth of Spring Creek	......	3.5	......	W.	W.	G.
Spring Creek: Grass and wood along creek for 3½ miles above this point	......	1.0	......	W.	W.	G.
Summit of pass of Un-go-we-ah range	......	4.5	......	......	......	......
Shell Creek, east side of Steptoe Valley, mail station	C.	2.1	181.0	W.	W.	G.
Steptoe Creek: Dry in summer	......	6.5	......	......	......	......
Mouth of Egan Cañon, in Montim range: Grass on side-hills	C.	6.8	194.3	W.	W.	G.
West side of Butte Valley: Water very scant; grass 1½ miles northeast from water-hole. It is probable that since Captain Simpson's explorations the mail station at this point has been changed to another and better locality in vicinity	C.	18.1	212.4	W.	W.	G.
Spring in Too-muntz range	C.	12	224.4	W.	W.	G.
Spring in Ruby Valley, mail station: Grass on west side of valley	C.	9.2	233.6	G. W.	W.	G.
South Fork of Humboldt	......	14.4	......	......	W.	......
Small mountain stream, west side of valley of South Fork of Humboldt; grass toward the mountains	C.	3.3	251.3	G. W.	W.	G.
Summit of Cho-kups Pass, of We-ah-bah range	......	4.0	......	......	......	......
West slope of We-ah-bah range	C.	3.0	258.3	S.	W.	G.
Spring in Pah-hun-nupe Valley	......	7.8	266.1	S.	W.	G.
Sulphur Spring, west side of Pah-hun-nupe Valley: Marsh grass; a better bunch grass in cañon northwest of spring	C.	5.5	271.6	G. W.	W.	G.
Summit of Cooper's range	......	8.9	......	......	......	......
She-u-wi-te or Willow Creek, in Ko-bah Valley: Some ten miles saved by taking a southwest direction from this camp, as indicated on map, to water; west slope of Pah-rea Mountain	C.	6.0	286.5	S.	W.	G.
Junction with Captain Simpson's return route: Take right hand	......	16.5	303.0	......	......	......
Twin Spring: Sergeant Barr's Springs, half mile west; little grass	......	2 0	305.0	S.	W.	G.
Junction of routes	......	5.0	......	......	......	......
Wons-in-dam-me or Antelope Creek: Abundance of wood, water, and grass	C.	1.5	311.5	W.	W.	G.
Fork of road: Take left hand	......	1.3	......	......	......	......
Saw-wid Creek: Water running one mile above; grass in cañon	......	3.0	......	S.	W.	G.
Dry Creek: Water running above road; grass in cañon	......	2.5	......	S.	W.	G.
Summit of Pah-rea range	......	7.1	......	......	......	......
Junction of roads	......	5.5	......	......	......	......
Fork of roads: Take left hand	......	2.4	......	......	......	......
Mouth of Won-a-ho-no-pe Cañon	C.	3.1	336.4	W.	W.	G.
Simpson's Park: Abundance of water and grass	C.	5.5	341.9	W.	W.	G.
Summit of Pe-er-re-ah, or High Mountain range	......	5.0	346.9	......	......	......
Fork of roads: Take left hand	......	4.5	......	......	......	......
Reese's River: Contains trout; fuel to be brought	......	5.0	356.4	......	W.	G.
Forks of road: Take right hand; (left hand 4 miles shorter, but more rugged over the Se-day-e Mountain range. This last best early in the season for trains going west, and always best for herds; water and grass at intervals of 2½, 10, 3, 3, 3, 7, 8; total, 36½ miles to junction with more northern road)	......	17.8	374.2	......	......	......
Kirby Smith's Creek, Woodruff Valley: Some grass along creek; abundant within the cañon of same creek	C.	3.5	377.7	G. W.	W.	G.
Mouth of Kirby Smith's Creek Cañon	......	3.2	380.9	W.	W.	G.
Road leaves Smith's Creek	......	3.0	383.9	W.	W.	G.
Summit of Pass of Se-day-e Mountains	......	1.3	385.2	......	......	......
Edward Creek	C.	.5	385.7	W.	W.	G.
Leave Edward Creek, in Dodge Valley	C.	7.0	392.7	S.	W.	G

APPENDIX A.—*Itinerary of the more northern or outward wagon-route from Camp Floyd, &c.*—Cont'd.

Localities.	Captain Simpson's camps.	Intermediate distances.	Total miles from Camp Floyd.	Fuel.	Water.	Grass.
Cold Spring: From this point, as far as Carson Lake, water and grass very scarce; water-keg should be filled at this point to cross desert	C.	11.2	403.9	S.	W.	G.
Cross small branch and join the other road; water sometimes running; sometimes stagnant in holes in small quantities	......	9	412.9	S.	W.	......
Gibraltar Creek, Middle Gate: Early in the season water running; at other times got by digging; at these times only sufficient for small parties; grass in vicinity, but scarce	C.	1.8	414.7	S.	W.	G.
Forks of road: Take left hand	......	23.5	438.2	......	......	......
Sulphur Spring: Little or no grass; water very scant	......	7.8	446	......	......	......
Carson Lake: Take road going south along the lake; rushes, but grass scarce; fuel brought; grass 5 miles north on lake	C.	9	455	R.	W.	R.
Forks of road: Take right hand	......	4.5	459.5	......	......	......
Leave Carson Lake: Fuel brought	C.	7.5	467	......	W.	G.
Carson River: Wood, water, and grass from this point up along river	C.	23.2	490.2	W.	W.	G.
Opposite Pleasant Grove: Cross Carson River here and join old Humboldt River road; can keep on along south side of River and cross at China Town	C.	18	508.2	W.	W.	G.
The river at Pleasant Grove and China Town only fordable late in the season	......	7.5	515.7	W.	W.	G.
Carson City, Eagle Valley	C.	11.8	527.5	S.	W.	G.
Genoa, (or regarding the cut-off indicated between Shu-wi-te Creek and the Pah-re-ah range, which saves about 10 miles, the total distance from Camp Floyd to Genoa, by Captain Simpson's more northern route, is 531 miles)	C.	13.8	541.3	W.	W.	G.

NOTE.—The distances were measured by an odometer. C. stands for camp; W. for wood; G. W. for greasewood; S. for sage; Wil. for willow; W. for water; G. for grass; and R. for rushes.

This itinerary has been prepared for emigrants; the cuts-off made by Captain S. on his return route to Camp Floyd being regarded. From She-u-wi-te Creek, west, therefore, it does not in every instance give the day's journey as indicated in journal.

In order to cross the desert between Simpson Spring and Fish Spring, and between Cold Spring and Carson Lake, with comfort, water-kegs should be provided for the persons of the party, and at least two grain-feeds for the draught-animals, one for each desert.

APPENDIX B.

ITINERARY OF MORE SOUTHERN OR RETURN WAGON-ROUTE FROM GENOA, IN CARSON VALLEY, OVER THE GREAT BASIN, TO CAMP FLOYD, UTAH.

Localities.	Captain Simpson's camps.	Intermediate distances.	Total miles from Genoa.	Fuel.	Water.	Grass.
Genoa	C.			W.	Wat.	G.
Carson City, Eagle Valley	C.	13.8	13.8	S.	Wat.	G.
China Town: Cross Carson River here early in the season by ferry or raft; later, by ford, or can cross at Pleasant Grove, 11¾ miles lower down, by same means		12.1	25.9	W.	Wat.	G.
Carson River, south side	C.	5.1	31.0	W.	Wat.	G.
Opposite Pleasant Grove, Carson River		2.0	33.0	W.	Wat.	G.
Carson River	C.	16.2	49.2	W.	Wat.	G.
Road leaves Carson River		1.9				
And goes over several sandy ridges to Carson Lake; fuel should be brought	C.	23.1	74.2	R.	Wat.	G.
Carson Lake: Fuel should be brought; rushes for feed; grass 5 miles farther north; water-kegs should be filled for crossing the desert, which commences here	C.	12.2	86.4	R.	Wat.	R.
Sulphur Spring, Alkali Valley: Barely sufficient for small party; little or no grass		9.0				
Junction with route: Take right-hand		7.7				
Middle Gate: Early in the season water running; later, to be got by digging; poor camping-place; grass in vicinity, but scarce; fuel should be brought		23.2			Wat.	G.
Cross small branch: Water in holes; take left-hand road; (right hand 4 miles shorter, but more rugged over the Se-day-e Mountains, and a very steep hill to ascend near summit. This last road always best for herds; abundance of water and grass can be found on it at intervals of 8, 7, 3, 3, 3, 10, and 2½, total 36½ miles, to junction with more northern road in Woodruff Valley)		1.8				
Cold Spring: Excellent water and grass	C.	8.2	136.3	S.	Wat.	G.
Edward Creek, Dodge Valley: Fine grass 2 miles farther up the cañon	C.	11.2	147.5	S.	Wat.	G.
Edward Creek and cañon	C.	7.0	154.5	W.	Wat.	G.
Summit of pass of Se-day-e range		6				
Kirby Smith Creek	C.	7.9	163.0	S.	Wat.	G.
Junction of routes		3.7				
Reese's River: Contains trout	C.	17.1	183.8	Wil.	Wat.	G.
Summit of pass of Pe-er-re-ah range		10.7				
Simpson Lake		4.8		W.	Wat.	G.
Won-a-ho-nu-pe River	C.	1.0	200.3	W.	Wat.	G.
Spring, Won-a-ho-nu-pe River: Take right-hand road	C.	4.8	205.1	S.	Wat.	G.
Junction of roads		3.8				
Fork of roads: Take right hand		2.6				
Summit of pass of Pah-re-ah range		4.6				
Cross Dry Creek: Water running half mile above; grass in cañon		7.4		S.	Wat.	G.
Cross Saw-wid Creek; water running 1 mile above; grass in cañon		2.8		S.	Wat.	G.
Wons-in-dam-me, or Antelope Creek	C.	4.6	230.5	W.	Wat.	G.
Fork of roads: Take left hand		1.6				
Twin Springs: Barr Springs half mile north; grass sufficient for small parties in vicinity		5.1		S.	Wat.	G.
Road crosses outward route		2.0				
Fountain Springs: About two acres of rush-grass		1.1		S.	Wat.	
Clay Creek: Plenty of grass above and below	C.	6.3	246.6	S.	Wat.	G.
Lee's Springs		5.2		S.	Wat.	G.
Sink of McCarthy's Creek		10.0		S.	Wat.	G.
McCarthy's Creek: Abundance of grass, wood, and water	C.	2.1	263.9	W.	Wat.	G.
Road leaves McCarthy's Creek		4.4				
Summit of We-a-bah range		1.8				
Leave Neill's Creek and take left-hand road (though, by striking across the valley (Buell's) in a northeastwardly direction, and joining the road in probably 6 miles, in mid-valley, you shorten the distance about 8 miles. The distance to Summit Spring very little farther, by this route, from Neill's Creek, than from Bluff Creek)		1.4		W.	Wat.	G.
Bluff Creek	C.	7.9	279.4	S.	Wat.	G.
Summit Spring, one-fourth of a mile east side of summit of pass of Too-muntz range	C.	32.4	311.8	W.	Wat.	G.
Ute Pete Spring and Creek		1.0				
Dr. Hurts' Creek and Cañon		11.9				
Summit of pass of mountain-range		3.2				
Spring, Spring Cañon: Several springs in vicinity, and grass.	C.	3.0	330.9	W.	Wat.	G.
Gate of Hercules, and spring, one-fourth of a mile left of road		8.2				
Lieutenant Murry's Creek, Steptoe Valley: abundance of grass and water	C.	5.8	344.9	S.	Wat.	G.
Captain Stevenson's Creek: Abundance of grass and water		3.6		S.	Wat.	G.
Captain Stevenson's Creek		7.5		W.	Wat.	G.
Spring, Stevenson Cañon	C.	3.4	359.4	W.	Wat.	G.

Itinerary of more southern or return route from Genoa, &c.—Continued.

Localities.	Captain Simpson's camps.	Intermediate distances.	Total miles from Genoa.	Fuel.	Water.	Grass.
Summit of pass of Un-go-we-ah or Perry range (some springs and grass about 1½ miles east of summit, to right of road, in branch of Captain Little's Cañon)		1.7				
Near mouth of Little's Cañon: The left-hand road goes direct to Turnley's Spring, and is the shortest		7.4				
Springs, Antelope Valley: Grass and cedars abundant half mile north	C.	6.6	375.1	S.	Wat.	G.
Turnley's Spring		8.1		W.	Wat.	G.
Summit of pass of Totts-arr or Goshoot range		1.8				
Un-go-pah, or Red Springs: Union Peak opposite	C.	7.2	392.2	Wil.	Wat.	G.
Rush Spring (small), Crosman Valley		10.9		G. W.	Wat.	G.
Crosman Creek, 3 feet wide, 1 deep; grass and water abundant	C.	3.9	407.0	Wil.	Wat.	G.
Plympton's Springs: Several in compass of half a mile, plenty of grass	C.	10.2	417.2	G. W.	Wat.	G.
Rush Pond: little or no grass; a few rushes	C.	21.3	438.5		Wat.	
Summit of pass of House range		12.2				
Chapin's Springs: Grass not abundant	C.	2.4	453.1	W.	Wat.	G.
Tyler's Springs: Grass limited; water-kegs should be filled here to cross desert	C.	15.5	468.6	W.	Wat.	G.
Summit of pass of Thomas' range		17.0				
Good Indian Spring, McDowell Mountains: A very small spring here; water-trough fixed for the collection and preservation of the water; grass and wood abundant	C.	18.0	503.6	W.	Wat.	G.
Prince's Creek, Champlin Mountains	C.	16.0	519.6	W.	Wat.	G.
Porter Creek, Porter Valley: Wood, water, and grass abundant		3.5	523.1	W.	Wat.	G.
Brewer's Spring: Wood, water, and grass abundant	C.	5.5	528.6	W.	Wat.	G.
Junction with outward route, in General Johnston's Pass of the Guyot range	C.	11.3	539.9	W.		G.
Meadow Creek	C.	10.0	549.9	G. W.	Wat.	G.
Camp Floyd: Grass and wood in Oquirr Mountains, 3 miles off	C.	18.2	568.1		Wat.	

NOTE.—The distances were measured by an odometer. C. stands for camp; W. for wood; G. W. for greasewood; S. for sage (*Artemesia*); Wil. for willows; Wat. for water; G. for grass; and R. for rushes.

In order to cross the desert, between Carson Lake and Cold Spring, and between Tyler's Spring and Prince's Creek, water-kegs should be provided for the persons of the party, and at least two grain-feeds for the draught-animals, one for each desert.

APPENDIX C.

ITINERARY OF A WAGON-ROUTE FROM FORT BRIDGER TO CAMP FLOYD.

Localities.	Intermediate distances.	Total miles from Fort Bridger.	Fuel.	Water.	Grass.
Fort Bridger	......	....	W.	Wat.	G.
Cañon Black's Fork	6	6	W.	Wat.	G.
Muddy Creek	7¼	13¼	W.	Wat.	G.
Last water in ravine	5½	18¾	S.	Wat.	G.
East Branch, Sulphur Creek	5¾	24½	S.	Wat.	G.
West Branch, Sulphur Creek	3½	28	Wil.	....	G.
East Branch, Bear River	5¼	33¼	W.	Wat.	G.
West or Main Branch of Bear River	3	36¼	W.	Wat.	G.
First Camp on White Clay Creek	9¾	46	W.	Wat.	G.
Foot of upper cañon: good camps in localities down to mouth of White Clay Creek	5¼	51¼	Wil.	Wat.	G.
Junction of White Clay Creek with Weber River and old Parley's Park road; turn up the Weber	19¼	70½	W.	Wat.	G.
Good camps up the Weber to point where you leave it to cross divide between it and Silver Creek	12	82½	W.	Wat.	G.
Silver Creek: Turn up the creek	6	88½	S.	Wat.	G.
Leave Silver Creek	3¾	92¼	S.	Wat.	G.
First camp on Timpanogos River	6	98¼	W.	Wat.	G.
Good camps at intervals to commencement of cañon	21	119¼	W.	Wat.	G.
Beautiful cascade	2¼	121½	W.	Wat.	......
Toll-bridge over Timpanogos	3¼	124¾	....	....	......
Mouth of Timpanogos Cañon	1	125¾	W.	Wat.	......
Battle Creek (Pleasant Grove): Fuel should be brought; forage purchasable	6¼	132	....	Wat.	......
American Fork (Lake City): Fuel should be brought; forage purchasable	3¼	135¼	....	Wat.	......
Lehi: Fuel should be brought; forage purchasable	3	138¼	....	Wat.	......
Toll-bridge over Jordan: Fuel should be brought	2¾	141	....	Wat.	G.
Camp Floyd: Fuel and grass in the mountains, 2½ miles off	14	155	....	Wat.	......

NOTE.—The distances were measured by an odometer. W. stands for wood; S. for sage; Wat. for water; Wil. for willows; and G. for grass.

APPENDIX D.

ASTRONOMICAL OBSERVATIONS

AND

GEOGRAPHICAL POSITIONS.

APPENDIX D.

ASTRONOMICAL OBSERVATIONS AND GEOGRAPHICAL POSITIONS OF THE MOST IMPORTANT POINTS.

The subjoined letters of Lieut. H. S. Putman, Topographical Engineers, and of Mr. D. G. Major, with the Table of Geographical Positions, give all needful information in respect to this portion of the expedition. The sextant observations were chiefly made by my assistant, Lieut. J. L. K. Smith, Topographical Engineers; the transit observations by Lieut. H. S. Putman, and those for lunar distance by both these officers and myself, the altitude of the moon and star, as well as the angular distance, being taken at the same instant of time.

The chief fact noticeable in the results is the disagreement between our longitudes and those of Colonel Frémont at Great Salt Lake City, the north bend of Walker's River, and at Genoa, the western termination of our routes, where our explorations have been either coincident or so closely approximate as to enable us to institute a comparison.

In Frémont's second expedition (1843–'44) he makes the longitude of the summit of Frémont Island, in Great Salt Lake, west of Greenwich 112° 21′ 05″. According to Stansbury's rigid triangular survey of Great Salt Lake, Salt Lake City is east of this summit 25′ 39″. This makes the longitude of Salt Lake City, as derived from Frémont's observations in second expedition, 111° 55′ 26″.

In Frémont's report of this expedition he remarks that "in this exploration, it became evident that the longitudes established during the campaign of 1842 were collectively thrown too far to the westward." He therefore abandons his determinations of his first expeditions, and assumes as correct those of his second. In his third expedition (of 1845–'46) he does not compare his longitudes with those of his previous expeditions; but, instituting a comparison myself, I find the result as follows: In this third expedition he makes one set of transit observations October 20, 1845, of the moon and moon-culminating stars, at the present site of Great Salt Lake City, and determines its longitude to be 112° 06′ 08″. That is, he makes the longitude of Salt Lake City in this expedition 10′ 42″ greater than in his second; or, in other words, moves collectively his positions back again westwardly 10′ 42″.

Now our observations of the transit of the moon and moon-culminating stars at Camp Floyd, consisting of five complete sets, made during two lunations, in the months of March and April, 1858, give a resulting longitude for this post of 112° 08′ 07″. Chronometrically, I found Great Salt Lake City east of Camp Floyd, 13′ 07″. This gives a resulting longitude for Great Salt Lake City, according to our observations, of 111° 55′ 00″, differing from Frémont's, in his second expedition, only 26″, and from his determinations in his third expedition, 11′ 08″. This result, I think, is corroborative of the accuracy of his longitude, as determined in his second expedition, and of our own.*

Again, Frémont makes the longitude of the most northern bend of Walker's River, in his third expedition, 119° 05′ 23″. We make the longitude of this same bend, by observations of east and west stars and lunar distances, 118° 56′ 00″, differing from his 09′ 23″, but as our station appears to have been about 2′ farther west than his, the disagreement between us amounts to about 11′ 23″.†

Thus far it will be noticed our disagreements have been 11′ 08″ at Salt Lake City, and 11′ 23″ at the most northern bend of Walker; but from this point westward, within a measured distance, by odometer, of only 60 miles along our route, and a difference of longitude of only 46′ 50″, our longitudes become suddenly so variant, as at the junction of the east and west branches of Carson River, at the base of the Sierra Nevada, to make us differ as much as 21′ 30″. Supposing, possibly, that I might have been in error, I have examined my map and notes critically upon this point, and feel confident that this suddenly enlarged discrepancy is not due to any errors we have committed. Besides, what makes me more disposed to think that the error does not lie with us is that Mr. George H. Goddard, the civil engineer who was intrusted by the State of California, in 1855, with the determination of the eastern boundary of that State, makes the longitude of Genoa 119° 48′ 25″,‡ or 7′ 55″ greater than mine, while Frémont's of this point, so far as it can be determined from its proximity to the junction of the east and west forks of Carson River, laid down on his map of his expedition of 1845–'46, is 21′ 30″ greater.

I have been thus particular in giving the points of difference between Frémont's longitudes and my own, from the circumstance that they have been hitherto regarded as correct, and succeeding explorers have referred their longitudes chronometrically to them as standards.

Before dismissing this subject, I cannot but bring to the attention of the Bureau the great importance of sending into the field, and of officers intrusted with expeditions of securing, the very best chronometers and astronomical instruments which can be purchased. A hundred dollars or more on a chronometer or other field-instrument may insure results which may be reliable and permanent; whereas a false economy which would be content with anything less will frequently jeopard the results of the whole expedition, and cause the expenditure of thousands of dollars, as well as the opportunity of gaining correct geographical knowledge, to have been entirely nugatory.

I would also state that the very best possible way we found of carrying our chronometers (four in number) was to place them in a soft-cushioned box prepared for the purpose, and to strap the box on the middle seat of an easy ambulance or spring-wagon. Our box-chronometer we allowed to play freely in the gimbals, only placing on the face of the chronometer a sufficient quantity of curled hair to restrict its oscillations within proper limits within the box and prevent its turning over.

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*My latitude of Great Salt Lake City differs from Frémont's 10″; from Stansbury's, 3″.

† Our latitude of this bend agrees within 26″.

‡ Mr. Goddard appears to have been supplied with all the requisite astronomical instruments to insure good results. See Annual Report of Surveyor-General of California, 1855, pp. 92–124.

I would here remark that according to my experience good chronometers can, with care, as above directed, be carried in our field-expeditions and very fair results be obtained from them, the precaution, however, being taken to determine the longitude absolutely at proper intervals,* as tests and checks of the work.

The astronomical observations which we took for time, or longitude and latitude, are so numerous as to make it inexpedient to incumber the report with them, but as they have been filed in the Bureau of Topographical Engineers, they are available for reference. I think it proper, however, to present below some of the forms we used for the entering of astronomical data; as they may be of service to future explorers.

As every hint of practical value is of use to explorers in the field I would suggest that in taking the altitudes of the sun with the sextant, I have found that to set the instrument, say every 20′ of arc, and wait for the contact or separation of the images,

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* I notice that Lieutenant Warren, in his memoir of explorations (Pacific Railroad Reports, vol. xi, 399), in comparing my longitudes on my exploration to the Navajo country from Santa Fé, in 1849, with those of Captain Whipple, of 1853 prefers those of Captain Whipple, for the reason that mine, as I stated in my report, were chronometric, and based upon the longitude of Santa Fé (106° 2′ 30′), as determined by Major Emory. This is all very well, for the reason that Captain Whipple determined his longitudes absolutely; but when the difference between us, 13′, is said "to be not greater than is liable to the method employed, viz, chronometric differences by chronometers transported over rough and mountainous country," he does me, doubtless unintentionally, an act of injustice; assigns an erroneous reason for the difference, and, according to my experience, makes the errors, liable from the cause assigned, very much greater than there is any necessity for. The truth is, the difference between Captain Whipple and myself arose not from the chronometers having been transported *over a rough country*, but because Major Emory had placed the longitude of Santa Fé too far to the westward; and hence, as mine were based on his, they were carried correspondingly 13′ too far to the westward, as was determined by Captain Whipple.

All this is corroborated by the fact that Capt. J. N. Macomb, topographical engineers, as his letter will show, by an observation of an occultation of the star B. A. C., 4984, August 5, 1859, has determined the longitude of Santa Fé to be 105° 47′ 14″.25 west from Greenwich; or 15′ 15″.75 to the eastward of that given by Emory.

WASHINGTON, D. C., *October* 22, 1860.

DEAR SIR: At your request I give you the result of my observations for longitude upon my recent exploration west of the Rio Bravo del Norte. At my camp upon the Rio Florido (a tributary of Rio Las Animas, which empties into the San Juan), I observed an occultation of B. A. C. 4984, on August 5, 1859, from which the longitude of 107° 46′ 30″ was obtained, and from this I deduced the longitude of Santa Fé by the use of a sidereal chronometer. My result for Santa Fé is 105° 47′ 14″.25.

I remain, very respectfully, yours, &c.,

J. N. MACOMB,
Captain Topographical Engineers, in Charge of San Juan Expedition, &c.

Capt. J. H. SIMPSON,
Topographical Engineers, U. S. A., in Charge of Explorations in Utah, &c.

I would also state that Lieutenant Warren has fallen into an error in respect to the real difference between my longitude of Fort Defiance and Captain Whipple's. He makes the difference 16′, whereas the real difference is 13′ 30″; thus:

My longitude of Camp No. 21, west mouth of Canoncito Bonito, as laid down in Appendix E of my report of Navajo expedition	109° 15′ 30″
Fort Defiance, east of this locality	3 00″
Longitude of Fort Defiance, according to my observations	109° 12′ 30″
Captain Whipple, longitude Fort Defiance, according to Lieutenant Warren	108° 59′ 00″
True difference	13′ 30″

Besides, in his table of comparative longitudes (doubtless a clerical error), he has entered Whipple's longitude of Ojos del Pescado, as 108° 14′ 18″. This makes a difference between my longitude of this place (108° 41′ 45″), and Whipple's, of as much as 27′ 27″. By reference, however, to Whipple's Table of Astronomical Positions, I find that the longitude of Inscription Rock has been placed down incorrectly, as that of Ojos del Pescado, and that the true longitude of the latter is 108° 27′ 54″, or differing from mine 13′ 51′.

has the advantage of securing uniformity of result, an avoidance of error in the hasty reading of the instrument and record of the angles, and a general satisfaction in the observations. Of course in the case of only occasional glimpses of the sun on account of intervening clouds this mode should not be practiced.

Lieutenant Putman submits results of observations for latitude and longitude.

WASHINGTON, D. C., *March* 1, 1860.

SIR: The subjoined table gives the geographical positions for the most important points on the new routes between Fort Bridger and Genoa, Utah.

It will be observed that the longitude of Camp Floyd, and consequently chronometrically, that of Great Salt Lake City, has been decreased about 11′ from that given by Colonel Frémont. This change, however, has been made only when a careful series of observations on the moon and moon-culminating stars warranted the alteration. These observations, consisting of five complete sets, were made during two lunations (in the months of March and April, 1859), and a mean of all the results, which did not differ essentially, was taken as the true longitude.

The longitude of Genoa is determined from a single set of observations of the same kind as the foregoing; the age of the moon and other circumstances, made it impossible to take as full a series as was desirable. Between Camp Floyd and Genoa other observations on the moon and moon-culminating stars, and of lunar distance were made for absolute determinations of longitude.

Equal altitudes of the sun, or double altitudes of "east and west stars," were taken at intervals which, with the known error and rate of the chronometer, affords the means for arriving at the longitude of intermediate points.

Latitude has been computed from double altitudes of the sun or Polaris at nearly every camp on the route.

The computations for latitude and time have been made by myself, assisted by Lieut. C. H. Collins, Topographical Engineers, and Mr. J. R. P. Mechlin; each computation being made by two persons to guard against mistakes. The longitudes by the moon and moon-culminating stars, and by lunar distances, have been computed by Mr. D. G. Major of Washington.

The instruments employed in the field were:

1st. A portable transit, made by Würdemann; focal length, two feet. After reaching Camp Floyd, the spider-lines of the reticle were found broken; they were replaced by such substitutes as could be obtained there, and it is believed the results are worthy of full confidence.

2d. One box, mean solar, chronometer by Parkinson and Frodsham, London, No. 1821, and two pocket chronometers, one, No. 221, by Frodsham, and one No. 8189, by A. P. Walsh, London. Of these, No. 1821 was used in most cases, and a proof of its reliability is to be found in the correspondence between the longitude as given by it, and that determined absolutely.

For instance, at the North Bend of Walker's River, the chronometer gives longitude 118° 56′ 08″ west from Greenwich, and an observation on the moon, Alpha Virginis, and Alpha Leonis, gives 118° 56′ 00″. Again at Clay Creek, the chronometer gives 116° 09′ 13″, while by lunar distances it is 116° 05′ 45″, a difference not great when it is remembered that the chronometer has been transported over 800 miles, and most of the way through a rough country, where there was no road.

3d. Two sextants made by Gamby (Paris), and one by Würdemann. All of these were used, simultaneously, by as many observers, in taking an observation for longitude by lunar distances.

The one marked "No. 1," was used by Lieutenant Smith, in all the observations made for time and latitude, and the results obtained from it were very satisfactory. In some cases a set of six pairs of equal altitudes of the sun would be taken, and on computing each pair separately, the greatest difference between any two errors, thus found, would seldom exceed a small fraction of a second; a proof of the extreme nicety of the observation.

I am, captain, very respectfully, your obedient servant,

H. S. Putman,
Lieutenant Topographical Engineers.

Capt. J. H. Simpson,
Corps Topographical Engineers.

Mr. Major submits results of calculations for longitude.

Washington, D. C., *February* 6, 1860.

Dear Sir: I have the honor herewith to inclose the essential calculations, and final results of the series of astronomical observations for longitude.

The transit work requires no explanation; the usual method of discussion having been adopted, so far as the data afforded.

The lunar distances have been computed by the improved method of Chauvenet, Astronomical Journal, vol. 2, also American Ephemeris, vol. 1. The places of the moon and stars, also other data, are taken from the American Ephemeris, with but one or two instances from the British Nautical Almanac.

I have to express regret that this work has been delayed, owing to an accident, by which the former calculations were destroyed. The inclosed results differ (in most cases very slightly), from those previously deduced on account of using these last as close approximations in the reductions.

Yours very truly,

D. G. Major.

Captain Simpson,
Topographical Engineers, U. S. A.

Table showing the geographical positions of the most important places between Camp Floyd and Genoa, Utah, on Capt. J. H. Simpson's outward route.

Place.	No. of camp.	North latitude.			Longitude west from Greenwich.		
		°	'	"	°	'	"
Camp Floyd		40	13	18	(c) 112	08	07
Meadow Creek	1	40	11	27			
Simpson's Spring	3	40	01	55	112	47	18
In the Desert	4	39	51	33			
Fish Spring	5	39	50	54			
In the Desert, (Sulphur Spring)	7	39	40	36	113	46	19
Pleasant Valley	8	39	41	12			
Antelope Valley	9	39	46	36			
Spring Valley	10	39	46	38			
Steptoe Valley	11	39	47	27			
Egan Cañon	12	39	51	46	(c) 114	58	15
Butte Valley	13	39	55	42			
Huntington Spring, east slope of Ruby Valley	14	40	00	29			
South Fork Humboldt River	16	39	55	39			
Pah-hun-nupe Valley	18	39	49	43	115	56	52
She-u-wi-te Creek	19	39	44	34			
Shelton Spring	20	39	29	56			
Clarke Creek	22	39	29	13	116	39	12
Won-a-ho-no-pe Creek	23	39	27	21			
Simpson's Park Creek	24	39	30	32	116	49	00
Reese River	25	39	29	29			
Smith Creek	26	39	20	28			
Putnam Creek	27	39	14	13	117	27	34
Gibralter Cañon	28	39	13	42			
Alkaline Springs	30	39	17	06			
Carson Lake	31	39	23	37	118	30	01
Walker's River	33	39	07	38	(d) 118	49	00
North Bend Walker's River	34	39	08	39	(d) 118	56	00
Carson City	37	39	09	24			
Genoa	38	38	59	33	(c) 119	40	30

Table showing the geographical positions of the most important points between Genoa and Fort Bridger, Utah, on Capt. J. H. Simpson's return route.

Place.	No. of camp.	North latitude.			Longitude west from Greenwich.		
		°	'	"	°	'	"
Carson River	4	39	16	18			
Carson Lake	5	39	16	47			
Cold Creek	7	39	23	06			
Edward Creek	8	39	28	56	117	31	42
Near summit of Se-day-e Mountain, (west side)	9	39	23	40			
Clay Creek	15	39	33	24	(d) 116	05	45
McCarthy Creek	16	39	32	51			
Bluff Creek	17	39	32	21			
Summit Spring	18	39	32	53	115	12	14
Spring Cañon	19	39	27	02			
Murry Creek	20	39	15	30			
Spring in Antelope Valley	22	39	06	09	114	26	52
Um-go-pah or Red Spring	23	39	05	21			
Crosman Spring	24	39	06	41			
Plympton Spring	26	39	15	56			
Rush Pond	27	39	19	37	113	31	54
Chapin Spring	28	39	20	09			
Tyler Spring	29	39	24	19			
Good Indian Spring	31	39	46	09	112	56	36
Prince Creek	33	39	52	24			
Brewer Spring	34	39	58	58			
Meadow Creek	35	40	05	41			
Torbert Creek, Round Prairie		40	29	25	111	25	56
Timpanogos River, (Bend of)		40	36	15	111	26	03
Weber River, (Crossing)		40	52	44	111	24	49
Near summit of Uintah Mountains, (side reconnaissance)		40	27	24			
Mouth of Duchesne Fork, (side reconnaissance)		40	09	50	110	20	33
Fort Bridger		41	20	23	110	23	47

NOTE.—The camps on the return route are numbered from Genoa, the camp at that place being No. 38 of the outward or No. 1 of the return route.

Longitudes marked *c* have been computed from observed lunar culminations; those *d* from lunar distances. All others are chronometric.

The longitude of Great Salt Lake City, chronometrically referred to the meridian of Camp Floyd, is 111° 55′ 00″. The latitude is 40° 46′ 03″ north.

[Form used.]

Comparison of chronometers, Camp Floyd, Utah, Tuesday, March 1, 1859.

Box chronometer No. 1821.	Pocket chronometer No. 221.	Difference.
h. m. s.	h. m. s.	h. m. s.
9 29 45	9 30 20	00 00 35
9 30 15	9 30 50	00 00 35
9 30 35	9 31 10	00 00 35
	Pocket chronometer No. 8189.	
9 31 44	9 35 50	00 04 06
9 32 04	9 36 10	00 04 06
9 32 44	9 36 50	00 04 06
	Pocket chronometer No. 8212.	
9 33 41	9 33 50	00 00 09
9 34 11	9 34 20	00 00 09
9 34 31	9 34 40	00 00 09

[Form used.]

Comparison of chronometers and daily rates.

Date.	No. of Camp.	Station.	No. of chronometer.	Reading of chronometer.	Difference.	Chronometer, fast (+) or slow (−) of mean time.	Chronometer, fast (+) or slow (−) of sidereal time.	+ fast or − slow of mean time.	+ fast or − slow of sidereal time.
1859.				h. m. s.	h. m. s.	h. m. s.	h. m. s.	m. s.	m. s.
Mar. 1		Camp Floyd, Utah Territory	1821	9 30 15		− 0 01 20.14	− 10 37 39.17		
1		do	221	9 30 50	00 00 35	− 0 00 45.14	− 10 37 4.17		
1		do	1821	9 32 04					
1		do	8189	9 36 10	00 04 06	+ 0 02 45.86	− 10 33 33.17		
1		do	1821	9 34 11					
1		do	8212	9 34 20	00 00 09	− 0 01 11.14			
10		do	1821	12 29 08		− 0 01 44.86	− 11 13 32.6	− 00 02.75	− 03 59.22
10		do	221	12 30 00	00 00 52	− 0 00 52.86	− 11 12 40.6	− 00 00.86	− 03 57.38
10		do	1821	12 30 11					
10		do	8189	12 35 25	00 05 14	+ 0 03 29.14	− 11 08 18.60	+ 00 04.81	
10		do	1821	12 31 28					
10		do	8212	12 31 05	00 00 23	− 0 02 07.86	− 11 13 09.6	− 00 04.68	

[Form used.]

Equal altitudes of sun's upper limb.—Camp Floyd, Utah, Thursday, March 3, 1859.—*Sextant No.* 5, *Würdemann box chronometer No.* 1821.—*Capt. J. H. Simpson, observer.*

A. M.		P. M.
h. m. s.	° ′ ″	h. m. s.
8 52 38	49 40 00	3 29 26
8 54 11	50 10 00	3 27 50
8 55 47	50 40 00	3 26 12
8 57 21	51 10 00	3 24 38
8 58 57	51 40 00	3 23 03
9 00 35	52 10 00	3 21 27
9 02 15	52 40 00	3 19 49
9 03 48	53 10 00	3 18 13
9 05 28	53 40 00	3 16 35
9 07 08	54 10 00	3 14 56
9 08 43	54 40 00	3 13 20

Index error.			Difference.	Mean.	Grand mean.	Atmosphere.
		′ ″	′ ″	′ ″	′ ″	
Bef. obs	On arc	34 40				A. M.
do	Off arc	30 10	− 4 30			Bar. 25, 423.
Aft. obs	On arc	34 50				Alt. ther. 56°
do	Off arc	30 00	− 4 50			Det. ther. 30°.
A. M	Sum		− 9 20	− 2 20		
					− 2 15	
Bef. obs.	On arc	35 00				
do	Off arc	30 40	− 4 20			P. M.
Aft. obs	On arc	35 00				Bar. 25, 320.
do	Off arc	30 40	− 4 20	− 2 10		Alt. ther. 61½°.
P. M	Sum		− 8 40	− 4 30		Det. ther. 47°.

[Form used.]

Astronomical observations with transit—Camp Floyd, Utah Territory.

Date.	Name of object.	Times of transit over the wires.							Illuminated end of axis.	Reading of level.				Observer.
										X end east.		X end west.		
		I.	II.	III.	IV.	V.	VI.	VII.		E.	W.	E.	W.	
1859.		*m. s.*	*m. s.*	*m. s.*	*h. m. s.*	*m. s.*	*m. s.*	*m. s.*						
Mar. 13	Sirius	11 11	11 32.5	11 56	7 12 17.8	12 39	13 02	13 24	......	590	550	590	550	
Mar. 13	Delta geminorum	....	44 12	....	7 45 00	45 23	45 46.5	....	......	590	550	590	550	
Mar. 13	Moon's W. limb	54 17	54 41.5	55 06.5	7 55 31	55 53	56 19	56 43	......	590	550	590	550	
Mar. 13	Beta geminorum	8 44	9 06	9 31	8 9 56	10 18	10 43	11 07.5	......	590	550	590	550	

APPENDIX E.

BAROMETRICAL AND METEOROLOGICAL OBSERVATIONS AND COMPUTATION OF ALTITUDE THEREFROM,

BY

HENRY ENGELMANN,
GEOLOGIST AND METEOROLOGIST OF THE EXPEDITION.

APPENDIX E.

REPORT ON THE BAROMETRICAL AND METEOROLOGICAL OBSERVATIONS AND ON THE COMPUTATION OF THE ALTITUDES THEREFROM, BY HENRY ENGELMANN, GEOLOGIST AND METEOROLOGIST OF THE EXPEDITION.

WASHINGTON, D. C., *December* 5, 1860.

SIR: I herewith submit to you my report on the barometrical and meteorological observations taken during the explorations under your command in Kansas, Nebraska, and Utah Territories, 1858 and 1859; and on the computation of the altitudes from the same, upon which the profiles are based, of the routes traveled by parties under your command between Fort Bridger, Utah, and the Sierra Nevada.

The observations cover a large area, and besides their value for the computation of altitudes, of which only those points west of Fort Bridger have been calculated, they afford an insight into the climatical conditions of the most elevated central portion of the North American continent. By their large number I have been enabled to deduce most striking results in regard to the fluctuations of the temperature and of the moisture of the atmosphere in the so-called Great Basin of Utah, which has an extremely continental climate, the like of which is only known to exist in the center of the vast continent of Asia, and also of several points in the plains, east of the Rocky Mountains, the climate of which, although not quite as arid as that of the Basin, still differs very materially from that of the intermediate valley of the Mississippi River and of the Eastern States, and presents insurmountable obstacles to the successful occupation of by far the largest portion of that region by any other than a nomadic population, the main interest of which cannot be agriculture. From the records of the observations given in full, much more interesting facts may be derived by their comparison with contemporaneous observations at other points; but my time has been too much limited to follow up the subject farther than I have done.

I avail myself of this opportunity to acknowledge the valuable assistance rendered me during the prosecution of the surveys, by Capt. J. W. Phelps, Fourth Artillery, U. S. A., (now resigned,) at Camp Floyd, and by Messrs. Edward Jagiello and William Lee, who assisted me along the route. For the communication of some of the meteorological records, which I have made use of in the computations, I am indebted to the Medical Department of the Army. I am also under obligation to Prof. A. D. Bache, Superintendent of the United States Coast Survey, for some observations at San Francisco, Cal., and for liberal access to the library of the Smithsonian Institution, and other facilities offered to me by the distinguished Secretary of the Institution, Prof. Joseph Henry.

I am, sir, your obedient servant,

HENRY ENGELMANN.

Capt. J. H. SIMPSON,
Topographical Engineers, U. S. A.,
In charge of Exploring Expedition.

INSTRUMENTS.

On starting from Fort Leavenworth, we were provided with three cistern barometers, Nos. 1062, 1237, and 1279, made by James Green, of New York, with scales graduated down to 20 inches, and with verniers reading to thousandths of an inch. These instruments, as improved now by Mr. Green, were again found to be admirably adapted to the wants of exploring expeditions, when they are transported over many hundreds of miles of rough mountain roads, and exposed to all accidents contingent to their daily use on the road and in camp. One of their principal advantages is the readiness with which they may be repaired in the field when damaged by long use or broken by accidents, which will happen to the most careful observer. Against such emergencies we were provided with several glass tubes, pure mercury, and other requisites. A portable tripod was furnished by Mr. Green with the instruments, and found very useful, indeed, indispensable. The immovable support which it gives can often not be obtained otherwise in the field, and adds to the correctness of the observations and to the preservation of the instruments.

We were also provided with aneroid barometers, which, however, were not used, as no reliable results could be expected from them at the elevation and in the climate where we might have needed them most. Besides these, we had a number of thermometers and a rain-gauge.

OBSERVATIONS.

Regular observations of the barometer, dry and wet bulb thermometers, cloudiness of the sky, direction and force of the wind, quantity of rain, &c., were kept up from the time of the arrival of the party at Fort Leavenworth, Kans., in May, 1858, to our return there in October, 1859. As it was desirable to obtain observations for as long a period as possible at each successive camp, and from the warmest to the coldest time of the day, the first observation was made soon after reaching a camp, and the last one shortly before leaving it again, conforming, as much as possible, to the hours of 6 a. m., 9 a. m., 12 m., 3 p. m., 6 p. m., and 9 p. m., which were fixed upon as the regular hours for observations when in camp. In the mountain regions, during the explorations between Camp Floyd, Utah, and Fort Bridger, Utah, and between Camp Floyd and Carson Valley, Utah, numerous observations were made on the road, with a view to the construction of the profile. Besides, a very large number of hourly observations were most carefully made at every point where a protracted stay offered an opportunity, in order to obtain data for the determination of the daily variation of the atmospheric pressure, the temperature, the elastic force and weight of vapor, and the relative humidity of the different districts.

REDUCTION OF THE OBSERVATIONS.

The first step, in preparing the records for discussion and computation, is the reduction of the observed readings of the barometer to what which they would have been had the temperature of the mercury been uniformly 32° Fahrenheit; for which purpose I made use of the tables of Prof. A. Guyot, of Princeton, published by the Smithsonian Institution.

INSTRUMENTAL ERRORS.

Next, the correction for instrumental error was applied. Before the barometers left the hands of the maker their scales were adjusted, so that they read precisely with the Smithsonian standard. Their comparative reading and the change which they had undergone was then tested by a long series of observations, made at Fort Leavenworth, under the direction of Capt. J. W. Abert, Topographical Engineers, which were repeated at Fort Kearney by myself, and afterward in every stationary camp, and as often as it appeared desirable. On the march we generally made use of only one barometer, to keep the others perfect for future service and comparison.

It will be sufficient here to give the errors as they were found at different times, without giving all the details regarding the determination and origin of their changes.

Table of zero-errors of the barometers.

Date.	Barometers.		
	1062	1279	1237
Found during May, 1858, (in inches English)	− 0.002	+ 0.002	− 0.002
End of June, 1858, (from most reliable observers)	0.000	0.000	− 0.004
End of July, 1858	0.000	0.000	− 0.005
After August 20, 1858, (1062 had been cleaned)	− 0.014	0.000	− 0.005
After September 2, 1858	− 0.014	− 0.005	− 0.005
After September 16, 1858	− 0.020	− 0.008	− 0.005
In January, 1859. (A new tube had been inserted in 1062)	− 0.042	(*)	− 0.006
In January, 1859, (1279 hand been refitted)	− 0.042	(*)	+ 0.005
In April, 1859	− 0.042	(*)	0.000
From June 1 to 21, 1859	− 0.055	(*)	0.000
After June 21. (A new tube had been inserted in 1279)	....	(*)	0.015
From August 28, 1859, to end	....	− 0.008	....

* Kept at Fort Bridger.

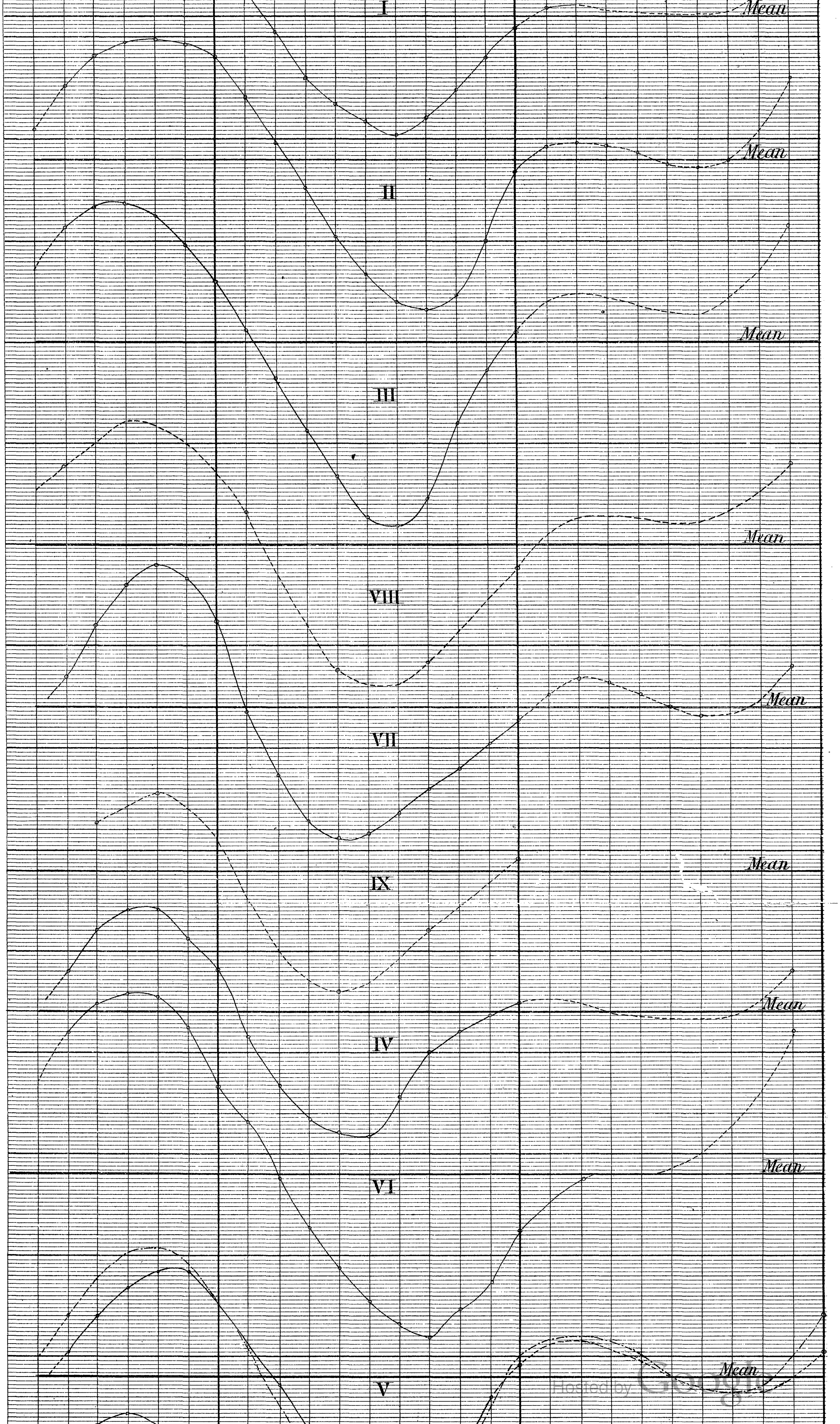
I wish to call the attention of observers who might meet with similar circumstances to the fact that, in determining these zero errors, I found a very valuable check in Part C, Table XXVII, of the second edition of the above-named Smithsonian Tables, which gives the depression of the mercurial column due to capillary action, with the internal diameter of the tube, and the height of the meniscus as arguments, reduced to English measure from a table of Delcros. The use of it may be seen from the following example: In January, 1859, at Camp Floyd, I had to replace the original tube of barometer No. 1062, which had been broken, by a new one. The inner diameter of the latter was 0.16 inch, while that of the former had been 0.20 inch. Having performed the operation with all possible care, I waited some days, in order to give the instrument time to obtain its normal conditions. I then compared it with the other, and found its zero-error equal to 0.042 inch. The meniscus of No. 1062 was now 0.024 inch high, which corresponds, according to the table, to a depression of 0.064 inch. To correct for the capillary attraction of the old and wider tube, the maker had shortened the scale 0.028 inch, as indicated by a mark on the brass tube. The apparent error, after the insertion of the new tube, ought, therefore, to have been 0.064 minus 0.028, equal to 0.036 inch. That the direct comparison gave it a little larger, 0.042, may be accounted for by my inability to measure the inner diameter of the tube to a fraction, as the beautifully clear sound of the instrument (produced when the mercury struck the closed end of the tube) indicated that the vacuum was perfect. The result certainly was very satisfactory. It proved that the zero-errors of the instruments had been recorded correctly, or very nearly so. I might, then, have shortened the scale, as the maker would have done in a similar case, being satisfied that this zero-error was not the consequence of a fault of the instrument, but of the increased capillary depression in the narrower tube. I preferred, however, to leave the scale unchanged.

In one case an accident happened to the two instruments, which, at the time, were the only ones in my possession. Some of the mules got entangled in the cords of the tent, and, pulling it down, threw the tripod, with both barometers, to the ground. Air entered the vacuum of No. 1062, and rendered it temporarily unserviceable. A bubble of air also entered the tube of No. 1279, but left it again on turning the instrument, which, from all appearances, had not suffered any permanent damage. The sound of the tube seemed to indicate that the vacuum was still perfect. After the tube of No. 1062 had been refilled, with all possible precaution, I found the result of calculation closely corresponding with the result of the direct comparison of the instruments, and in this way I was again re-assured that No. 1279 had not suffered from the accident, an assurance which I could not well have arrived at in any other way. These examples show how useful it is to keep account of the width of the tubes, the height of the meniscus, the clearness of the sound, and other observations in regard to the condition of the instruments.

The thermometers—the attached as well as the detached ones—also did not perfectly agree with each other. I therefore tested their graduation by direct experiments, from which I calculated a table of corrections. The readings of the thermometer, as found in the records, were thus corrected whenever it was found necessary.

METHOD OF COMPUTATION.

I could scarcely hesitate in the selection of the method for computing the altitudes, since the one developed according to the requirements of the case during the computation of the profiles of the Pacific Railroad surveys, and discussed by Lieut. Henry L. Abbot, Topographical Engineers, in Vol. VI of the Reports (to which I refer for particulars), gives results which may be regarded as absolutely correct, as demonstrated by Lieutenant Abbot, if suitable corrections can be obtained; and under less favorable circumstances, the results are at least more generally reliable than those obtained in any other way. By the introduction of the corrections for horary and abnormal oscillations of the barometric column, if such can be obtained from points of similar climatical features, not too far distant, nor differing too much in altitude from the point the altitude of which is to be determined, all causes of error are eliminated the more the nearer these conditions are fulfilled, including the effects of the


I
Mean
II
Mean
Mean
III
Mean
VIII
VII
Mean
Mean
IX
Mean
IV
Mean
VI
Mean
V

aqueous vapor in the atmosphere upon its pressure, which we cannot bring into calculation in any other way with a reasonable hope of success. This constitutes one of the most prominent advantages of the new method. Those formulæ in which the atmospheric moisture appears as a separate element are open to a great many objections, and in their application we meet with obstacles which we are not now prepared to overcome. The most prominent among them is our want of accurate knowledge of the laws of the distribution and transmission of moisture through the atmosphere, and the great variability of its amount in different strata of the air, depending partly on altogether local influences, which may not extend beyond the lowest strata of the atmosphere. Only under particularly favorable circumstances these formulæ can be expected exceptionally to give very favorable results.

The new method required the use of a mean reading of the barometer and thermometer at the fixed station, and the corrections which are applied give an approximation to the mean reading of the barometer at the station the altitude of which is to be determined. If this mean was really obtained, then the mean temperature of the place would give the correct result; but as the corrections fail to be perfect, the introduction of the mean temperature of the respective day or days seems generally to give the best results.

CORRECTIONS FOR THE HORARY OSCILLATIONS OF THE MERCURIAL COLUMN.

The horary oscillations differ according to the latitude, climate, and altitude of the stations, and the seasons of the year. Their values for the regions traversed by us were not known. I determined them, therefore, for as many points as it could be done. Hourly observations were made for the purpose, mostly during 16 hours of each day, and kept up for several days or weeks. From these the variations were deduced, with the aid of diagrams and interpolations, as described by Lieutenant Abbot. The following table exhibits the results obtained, which are also graphically illustrated by the curves on Plate A, on an enlarged scale. The full black lines in those diagrams connect the computed hourly means, while the dotted lines, like the values put in brackets in the following table, are not actually determined by observations:

A.—*Corrections for the horary oscillation of the barometric pressure.*

[In inches (English) of the mercurial column.]

Hours.	I.	II.	III.	IV.	V.	V *a*.	VI.	VII.	VIII.	IX.	X.
5 a. m	[—.008]	[—.007]	[—.018]	[—.000]	[—.000]	[—.004]	[—.023]	....	[—.014]	....	[—.018]
6 a. m	—.013	—.018	—.028	—.010	—.006	—.015	—.035	—.013*	—.019	....	—.027
7 a. m	—.018	—.026	—.033	—.020	—.015	—.026	—.042	—.020	[—.026]	—.012	—.033
8 a. m	—.022	—.029	—.034	—.026	—.022	—.031	—.045	—.030	[—.030]	....	—.036
9 a. m	—.022	—.029	—.031	—.025	—.026	—.032	—.044	—.035	—.028	—.024	—.033
10 a. m	—.018	—.028	—.024	—.018	—.026	—.028	—.036	—.032	[—.025]	....	—.026
11 a. m	—.013	—.025	—.014	—.010	—.019	—.019	—.022	—.021	[—.019]	....	—.016
12 m	—.006	—.015	—.003	+.006	—.008	—.007	—.008	+.001	—.008	+.007	—.002
1 p. m	+.004	—.004	+.009	+.018	+.002	+.007	+.006	+.017	[+.007]	....	+.010
2 p. m	+.015	+.007	+.022	+.027	+.013	+.018	+.018	+.028	[+.021]	....	+.019
3 p. m	+.021	+.019	+.033	+.030	+.024	+.029	+.028	+.032	+.031	+.030	+.026
4 p. m	+.025	+.028	+.043	+.031	+.025	+.035	+.036	+.031	[+.034]	....	+.031
5 p. m	+.029	+.035	+.045	+.021	+.025	+.038	+.042	+.026	[+.034]	....	+.032
6 p. m	+.025	+.037	+.039	+.010	+.024	+.033	+.046	+.020	+.029	+.015	+.032
7 p. m	+.018	+.034	+.020	+.005	+.018	+.020	+.038	+.015	[+.021]	....	+.030
8 p. m	+.010	+.020	+.007	+.001	+.005	+.006	+.027	+.009	[+.013]	....	+.023
9 p. m	+.003	+.003	—.003	—.002	—.003	—.005	+.014	+.003	+.006	—.003	+.012
10 p. m	....	—.003	....	....	....	—.008	....	....	....	....	....

*6.30 a. m.

No. I was deduced from 23 days' hourly observations taken at Fort Leavenworth, Kans., from May 3 to 26, 1858, at an elevation of near 900 feet above the level of the sea. The mean temperature during that time was 59° Fahrenheit, the weather rainy and stormy. The hourly variations were often obliterated by the abnormal changes, and the amplitude of the diagram is, therefore, comparatively small; it corresponds very nearly with that for the same month at Philadelphia.

No. II was deduced from observations taken at Fort Kearney, Nebr., from June 19 to July 1, 1858, at an elevation of 2,200 feet above the level of the sea. The mean temperature was 77°.5, the weather mostly fine, with the exception of some rains and high winds. Great abnormal variations took place during this interval, but I found that they did not change much the mean result. Therefore I eliminated only one very irregular day, and calculated the table from the remaining 11 days, after correcting a few obvious irregularities. The values thus obtained are very satisfactory.

No. III was deduced from 4 days' observations taken at Fort Laramie, Nebr., from July 30 to August 1, 1858, at an elevation of about 4,470 feet above the level of the sea, and with a mean temperature of 67°. The weather was rather favorable. The diagram has a marked sweeping shape.

No. IV was deduced from observations taken at Fort Bridger, Utah, from September 28 to October 7, 1858, at an elevation of 6,656 feet above the level of the sea. The weather turned out so stormy, and the variations so irregular, that I had to reject all observations made after the first 2 days, which have a mean temperature of 57°.

No. V was deduced from observations taken at Camp Floyd, Utah, at an elevation of 4,860 feet above the level of the sea, from April 4 to 23, 1859. The mean air temperature was 42°, and the weather mostly cloudy, stormy, and rainy. The amplitude is, therefore, rather small.

No. V *a*. A more graceful diagram and of larger amplitude was obtained from only the first 3 days of No. V, from April 5 to 8, 1859, with a mean temperature of 41° and fine weather.

No. VI was deduced from 3 days' observations taken at Camp Floyd, Utah, from August 6 to 9, 1859. The mean temperature was about 70°, and the weather clear and favorable, with the exception of some high winds.

No. VII was deduced from 10 days' hourly observations taken at Camp Floyd, Utah, from October 30 to November 9, 1858. The mean temperature was about 35°, the weather fine, and no great abnormal variations took place. These results are, therefore, of superior value. The diagram shows a bold, sweeping shape.

No. VIII was deduced from 22 days' tri-hourly observations at Camp Floyd, Utah, taken by Capt. J. W. Phelps, Fourth Artillery, from September 22 to October 13, 1858. The mean temperature was 57°, the weather partly stormy. The values for the intermediate hours were found by plotting the calculated ones, and combining them by a curve, which seemed best to correspond to the other diagrams.

No. IX was deduced from tri-hourly observations taken at Camp Floyd, Utah, from November 3 to 29, 1858. The mean temperature was 35°, the weather mostly calm and clear, but some great abnormal variations took place, and some snow fell. The amplitude is, therefore, smaller than in No. VII.

No. X was deduced from observations at Genoa, Carson Valley, Utah, at an elevation of 4,824 feet above the level of the sea, taken from June 12 to June 23, 1859. The mean temperature was 76°.3, and the weather fine; but the condition of the atmospheric pressure was not as uniformly regular as might have been desired. The diagram has, therefore, a less marked shape and amplitude than one might expect, but it must be remembered that the situation of Genoa is a peculiar one, on the margin of the arid interior, not far from extensive deserts, but also close to the foot of the Sierra Nevada, with its snow-clad summits, its abundance of water, and luxuriant vegetation.

I also tried to obtain the barometric variations in Woodruff Valley, one of the desert valleys of the interior of the Basin, at an elevation of nearly 6,000 feet above the level of the sea, at the end of May, 1859. The mean temperature there was then 53° Fahrenheit. But as a barometric storm occurred in these days, I did not obtain satisfactory results. I can only state that the barometer seems to oscillate very little between sunrise and noon, that then it sinks for some hours and begins to rise again rather abruptly toward sunset. The peculiarity of this change is due to the influence of the aqueous vapor, or rather to the extraordinarily small amount of aqueous vapor in that region, as will appear from the discussion of that subject below, while we might expect a large amplitude on account of the large daily oscillation of the temperature.

These tables of oscillations were made use of for correcting the observations, either directly or by combining them so as to answer the purpose more satisfactorily. Most of the camping-places along our routes in Utah did not require very large corrections, partly on account of their high altitudes, which mostly varied between 5,500 and 7,000 feet above the level of the sea, partly on account of the reason stated above. The largest corrections were needed in the neighborhood of Carson Lake, and at some other low points with high temperatures; but in no instance were the oscillations found nearly as large as those observed by Lieutenant Abbot at a much lower elevation with higher temperature, in August, at Fort Reading, in the Sacramento Valley, or those obtained farther south, in New Mexico.*

CORRECTION FOR THE ABNORMAL VARIATIONS OF THE ATMOSPHERIC PRESSURE.

The amount of this variation differs much according to the climatical character and elevation of the stations. There was no meteorological station in the interior of Utah, in the climatical zone of our survey, besides that at Camp Floyd, where barometric observations were taken under direction of the medical department of the Army. Although we went several hundred miles from that place and passed high ranges of mountains, I considered it safe to apply the corrections indicated by the changes of the barometer at Camp Floyd, as it is a well-established fact that the variations extend over hundreds of miles of the same zone with little change. Although we were part of the time nearer to San Francisco, I preferred to base the corrections throughout on Camp Floyd, because the climate of San Francisco is one of periodical changes, while that of the interior is non-periodic, and because San Francisco is several thousand feet lower than the Basin. The difference of the monthly mean readings of the barometer from the yearly mean has not been found analogous in both districts, although many of the great variations of the atmospheric pressure will undoubtedly be felt simultaneously in the interior of Utah and on the Pacific coast.

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* I am compelled to confine myself merely to allude here to the change of the amplitudes, in value and time, in the different months and localities, and to the more gradual or abrupt increase or decrease of pressure which is graphically represented in the diagrams; nor can I discuss the varying influence of the elastic force of vapor in the atmosphere upon the oscillations of the barometer at the different hours of the day, and in the different seasons of the year. These interesting questions must be left to future investigation. They are by far not so easily solved as it would appear from a superficial examination.

The diagram of the observations at Camp Floyd, corrected for the horary oscillations, showed in general a satisfactory agreement with the corresponding diagrams of the single camps, and even for the most western point reached by us; for as regards the city of Genoa, in Carson Valley, Utah, these diagrams agree better with each other than those for Genoa and San Francisco. Local storms and rains in the single mountain ranges affect the parallelism of the diagrams in some instances; but the differences produced in that way are probably not considerable, and partly, at least, are counterbalanced by the corresponding changes in temperature, &c.*

Between the abnormal variations of the barometers at Camp Floyd and Fort Bridger I also found a most remarkable coincidence, and nearly simultaneous changes, when I plotted the diagrams of corresponding observations, made very carefully at these points in September and October, 1858.

CORRECTION OF THE OBSERVED AIR-TEMPERATURES.

The method of computation requires the introduction of the mean temperatures of the days, instead of the observed temperatures. To find the mean temperature more accurately, and make the correction more systematic, I have deduced the following tables from observations made in connection with the hourly observations of the barometer for determining the horary oscillations of the mercurial column. These interesting tables show the mean difference of the temperature of each hour from the mean temperature of the day for different stations and seasons. The curves on plate B represent these variations graphically. The marks * indicate the times of sunrise and sunset.

As no observations had been made during the hours of night, the mean temperature of the twenty-four hours was calculated under the supposition that the temperature decreases regularly from 9 p. m. to near sunrise, which, in the highly elevated regions, comes very near the truth.

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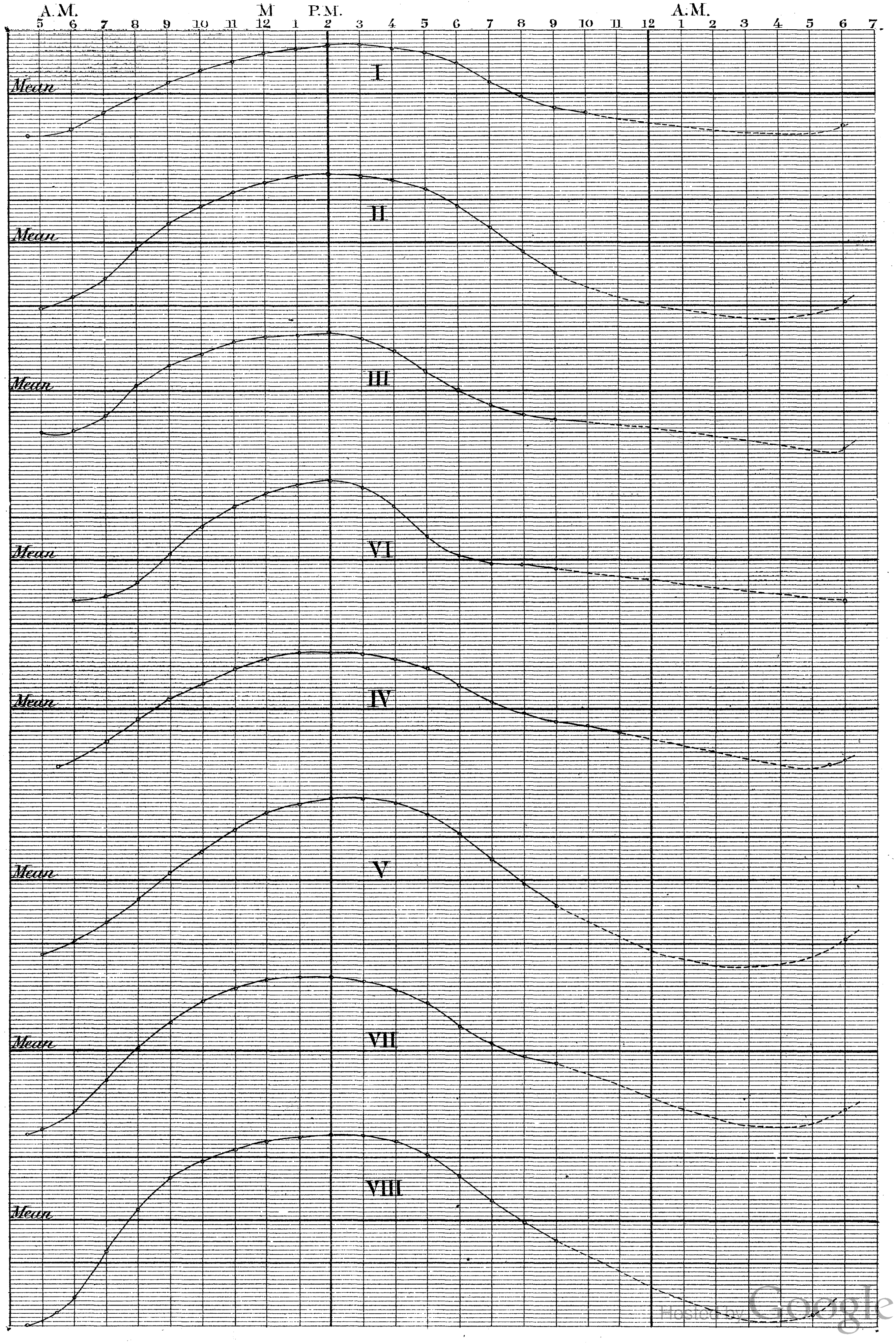
* Long after the computation of the altitudes had been finished, I took up the study of the hygrometrical observations, the leading results of which will be found in the latter portion of this report. They impressed me still more with the necessity of selecting, as a lower or fixed station, a point which actually presents the same climatical features as the station the altitude of which is to be determined. I found, besides, that when the local storms occur, the hygrometrical observations will enable an experienced meteorologist to apply some discretionary corrections and to judge better the comparative accuracy of the results of different computations; although I still repudiate the introduction of the force of vapor into the hypsometric formulæ. By them he is also enabled better to judge which one of the various tables of horary oscillations is best adapted to the single observations.

Hourly Variation of Temperature
at different stations and seasons.



B.—*Corrections for horary oscillation of temperature, in degrees, Fahrenheit.*

Hours.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
5 a. m	[+ 9.8]	[+15.2]	....	+13.0*	+17.5	....	[+19.0]	+22.0*
6 a. m	+ 8.0	+13.8	+10.0	+11.7	+14.5	+ 9.5†	+14.0]	[+18.0]
7 a. m	+ 4.8	+ 8.2	+ 5.7	+ 7.0	+10.0	+ 9.2	+ 7.0	[+ 8.0]
8 a. m	+ 1.5	+ 1.7	— 1.7	+ 2.3	+ 4.5	+ 5.5	— 0.5	[— 3.0]
9 a. m	— 2.0	— 4.5	— 6.0	— 2.0	— 1.0	— 0.5	— 6.5	—10.0
10 a. m	— 5.2	— 8.7	— 9.0	— 6.3	— 6.5	— 7.0	—11.0	[—14.0]
11 a. m	— 7.5	—11.7	—11.0	— 9.5	—11.5	—12.0	—14.0	[—16.0]
12 m	— 9.2	—13.7	—13.0	—11.5	—15.5	—15.0	—16.0	—18.0
1 p. m	—10.5	—15.2	—13.5	—13.0	—18.0	—17.0	—17.0	[—19.0]
2 p. m	—11.2	—16.0	—13.5	—13.5	—18.5	—18.5	—17.0	[—20.0]
3 p. m	—11.2	—15.5	—12.0	—13.0	—18.5	—17.0	—16.0	—20.0
4 p. m	—10.5	—14.5	— 9.0	—11.7	—18.0	—13.0	—14.3	[—18.5]
5 p. m	— 9.5	—12.5	— 4.7	— 9.7	—15.0	— 6.0	—11.0	[—15.5]
6 p. m	— 7.0	— 9.0	0.0	— 5.7	—11.0	— 1.0	— 5.0	—11.0
7 p. m	— 2.3	— 4.0	+ 3.3	— 1.0	— 5.0	0.0	— 1.5	[— 4.5]
8 p. m	+ 1.3	+ 3.0	+ 5.3	+ 1.3	+ 1.5	+ 1.0	+ 1.0	[+ 1.0]
9 p. m	+ 3.3	+ 7.0	+ 6.3	+ 3.0	+ 5.5	+ 2.0	+ 3.2	+ 4.7

* 5.30 a. m. † 6.30 a. m.

No. I was deduced from 9 days' observations at Fort Kearney, Nebr., taken between June 19 and July 1, 1858, at an elevation of 2,200 feet above the level of the sea. Three more days' observations were rejected on account of great irregularities, in consequence of rain. The mean temperature was 77°.5; the weather mostly fine.

No. II was deduced from 4 days' observations taken at Fort Laramie, Nebr., from July 30 to August 3, 1858, at an elevation of 4,470 feet, with a mean temperature of 67°, and favorable weather.

No. III was deduced from 6 days' observations at Fort Bridger, Utah, taken from September 28 to October 4, at an elevation above the sea of 6,656 feet, with a mean temperature of 53°. The weather was mostly fair, partly cloudy and rainy. Some more days' observations had to be rejected on account of a snow-storm.

No. IV was deduced from observations taken at Camp Floyd, Utah, from April 4 to 23, 1859, at an elevation above the level of the sea of 4,860 feet, with a mean temperature of 42°. The weather was partly clear, but mostly cloudy, even with some snow and rain. The diagrams of the single days are very irregular, but as the observations had been taken so long, it was not considered necessary to eliminate the irregularities. The mean variations, which are given in the table, include them all.

No. V was deduced from 3 days' observations taken at Camp Floyd, Utah, from August 6 to 9, 1859, with a mean temperature of 69°.5, and clear, favorable weather.

No. VI was deduced from observations taken at Camp Floyd from October 30 to November 10, 1858, with a mean temperature of 35°. The weather was calm and clear, and the diagram presents, therefore, sharply marked features.

No. VII was deduced from observations taken at Genoa, Carson Valley, Utah, at an elevation of 4,824 feet above the level of the sea, from June 12 to 23, 1859. The mean temperature was 76°.3, the weather fine and clear. The shape of this diagram, with its early maximum, may be due partly to local causes incident to the peculiar situation of the camp.

No. VIII was deduced from 2 days' tri-hourly observations in Woodruff Valley, one of the desert valleys of the interior of Utah Territory, at an elevation of 5,940 feet above the level of the sea, taken end of May, 1859, with a mean temperature of 53°, and clear weather.*

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* A diagram of still more marked shape was obtained from 2 days' observations at Camp Floyd, in the middle of September. It has the excessive amplitude of 48°.3 Fahrenheit. More will be said of it below.

It is scarcely necessary to remark that, in the application of these corrections, proper discretion is required on the part of the computer, and that the tables are merely intended to help him. While the variations are smaller on a clouded and rainy day, not favorable for radiation, they are larger on a clear day, and much depends upon local circumstances, and the direction and force of the winds, &c. When the successive camps and minor stations are in the same valley, or do not differ much in altitude and physical relations, the mean temperatures may be determined with great precision; but where the altitude and relative position of the stations vary much, as they did on our survey in Utah, from low, arid valleys or scorched slopes to narrow cañons or high mountain summits, it is very difficult to determine the mean temperature of the day from one or a few observations, the more so because the hour of the maximum temperature also changes according to the relative situation of the stations.

SELECTION OF A FIXED STATION.

After all these corrections had been applied, the observations were ready for computation. The tables of Prof. A. Guyot, based on La Place's formula, were used for this purpose. Next the question arose what should be taken as the lower or fixed station for the calculation of the altitudes in Utah. As most of them are considerably high, between 5,000 and 8,000 feet, the air-temperature appears as an important element in the computation. A difference of 1 degree in the temperature changes the result 1 foot for every 900 feet of the height. By taking the sea-level as the lower station, with a comparatively high mean temperature, this element appears to exercise an unduly great influence on the result, after all the corrections have been applied, which, if fully answering the purpose, would require the mean temperature of the year to be used, not the one, generally much higher, of the day of the observation.

Camp Floyd was an elevated inland station, for which the mean reading of the barometer and thermometer could be ascertained, and the altitude of which could, therefore, be determined satisfactorily. By taking Camp Floyd as the lower station, I decreased in a great measure the influence of the temperature in the computations, and all errors arising from that source. The altitudes of all places not very far from Camp Floyd were certainly obtained much more correctly in this way, and I believe also most of the others; at least I obtained by this method results which agreed very satisfactorily in several cases when observations, taken at different times, controlled each other, while the use of the sea-level as the lower station would mostly have given greater discrepancies.

It might be urged that, in case the altitude of Camp Floyd was not correctly determined, this error would be propagated by assuming it as the fixed station. The error in the altitude might originate from various causes: Firstly. The values assumed as mean readings of barometer and thermometer at the level of the sea might not be those best adapted for the special purpose; then the computer would introduce the same causes of error into the other calculations, and the results would be obtained even more uniform on assuming an intermediate station for references. Secondly. The mean reading of barometer and thermometer, as given for Camp Floyd, might not be absolutely correct. This error cannot be great. If the values did not correspond to the station of Camp Floyd, they would correspond to an imaginary one a few feet higher or lower. The altitude computed for Camp Floyd would then be that of this imaginary station, and the other altitudes would not be affected by that error at all, but would be obtained correctly. Lastly. It might be doubted whether the altitude of a station far inland, with a peculiar climate, could be determined correctly, even from the yearly mean reading of the barometer and thermometer, and that thus the elevation computed for Camp Floyd might be incorrect. Errors arising from that source would certainly be much greater if minor inland stations were directly compared with the sea-level, than if they were computed with reference to a station with their own climatical features, the altitude of which had been determined from a whole year's observations. If not correct, the elevation would then at least be obtained more relatively correct among themselves. The introduction of the corrections for horary and abnormal variations has done a great deal toward eliminating errors from that source, but as these corrections cannot possibly be found to suit each single observation, I consider it the best policy to decrease the liability of errors in the results of calculation by decreasing the altitude between the upper and lower stations; in other words, by assuming Camp Floyd as the lower station instead of the level of the sea.

The lowest portion of the route is lower than Camp Floyd, and I hesitated to make use of that station as the fixed one. Still, I considered it better to retain uniformity in the computations. The different values obtained for the altitude of Genoa, in Carson Valley, by the different modes of computation, will show the advantages of the method followed by me. Twelve days' careful observations had been taken there, and minor errors were thus eliminated. The diagrams of the abnormal variations of the barometers at Genoa and Camp Floyd, as well as their mean readings for those days, correspond well together, as I have stated above, and the temperature at the time was very high at both points. If the altitude of Camp Floyd had been calculated from these observations only, by whatever method, it would have been found very near equal to that of Genoa computed in the same way. By my method this was obtained. I found Genoa 4,824 feet high, while Camp Floyd is 4,860 feet high. I then computed the altitude with reference to the mean reading at the level of the sea, and the abnormal oscillation observed at Camp Floyd. I found it 5,004 feet, which is much too high, because in this case, where the corrections give a nearly exact compensation, the mean temperature of the year only would give a good result, while the high temperature of these days, in connection with the great difference of level between the upper and lower stations, raises the result unduly. Again, I computed the altitude with reference to observations during the same days at San Francisco, thus introducing the very large abnormal oscillation of the barometer in the middle of June at that place, which, I felt satisfied, was larger than the correction required for Genoa, but which might have been compensated by the high degree of temperature. Thus I obtained the altitude, only 4,633 feet (as near as I could get it without some corrections, the values of which were unknown to me). It will be seen that the mean of these two extreme results, 5,004 and 4,633, happens to be 4,818, very near what my method gives. This example shows forcibly what I consider as the advantage of computing from a fixed station, which does not differ too much in altitude from those which shall be determined, namely, that extremes of error are thus avoided, although in single instances other methods may give better results. In calculating the profile of a country, quite different rules must be followed from those best answering for the computation of the altitude of a single mountain.

The altitudes of points on the roads between Camp Floyd and Fort Bridger, Utah, were computed before the yearly mean readings at Camp Floyd had been determined. I had, therefore, to make use of the corresponding readings of the barometer at both stations, which answers the same purpose, and of the mean temperature of the days. But as the temperature, during the season of these surveys, was generally moderate, and the difference of the altitude of the upper and lower stations mostly not very considerable, the obtained values must be nearly correct. The altitude of Fort Bridger, determined in that way, agrees perfectly with that obtained from a large mean. Some of these observations could not be referred to simultaneous observations at Camp Floyd or Fort Bridger, and I had to compare them with such obtained on the same days at other camps, the altitudes of which had been determined before, or even with camps of the preceding and following days. Although this method is very objectionable as a general thing, I consider the results in this case as more reliable because the circumstances were uncommonly favorable; and especially the corrections for the daily variations of the barometer gave such complete compensation that the plot of the barometric readings of the single stations could be filled up satisfactorily for the intervening hours. Of the different values thus obtained for a point, the means were taken, which probably give a close approximation to the real altitudes.

ALTITUDE OF CAMP FLOYD.

The determination of the mean reading of the barometer and thermometer at Camp Floyd was a matter of considerable importance to me, because I wanted to make use of them, and the altitude of the station computed from them, as a basis for most of the other computations, as I have stated above. At our station observations had been regularly taken during the 6 months from November, 1858, to April, 1859; partly hourly, 16 a day; partly 6 every day, and partly at the hours of 7 a. m., 2 p. m., and 9 p. m., every day. The mean of these was calculated with due reference to the different number of observations, and the necessary corrections were applied. This mean was found to be 25.129 inches at 32° of the mercury. The results of observations during the next 6 months, from May to October, 1859, regularly taken at the hospital at Camp Floyd, at the hours of 7 a. m., 2 p. m., and 9 p. m., were kindly furnished by the medical department. Their mean, reduced to our standard and station, is 25.150 inches. The mean for the whole year is, therefore, 25.140 inches, English, at 32° of the mercury.

The mean temperature of the year was deduced from 6 months' observations at our station; 3 months' observations by Asst. Surg. Thomas H. Williams, medical director of the Department of Utah, and 3 months' observations at the hospital, under direction of Asst. Surg. J. Moore, U. S. A. It is 47° Fahrenheit.

I assumed 30.050 inches as the mean reading of the barometer, the mercury reduced to 32° Fahrenheit, and 54° as mean air temperature at the level of the sea, best adapted for the computation of the altitude of Camp Floyd and points of a similar geographical position. It is the mean of the values corresponding to the Pacific coast in the neighborhood of San Francisco, and to the Atlantic coast near the 40th parallel of latitude. I thus obtained the altitude of Camp Floyd as 4,867 feet. To test the correctness of this result, I computed the elevation of Fort Bridger from a mean of 8 months' observations, taken there from January to August, 1859, under direction of Asst. Surg. R. Bartholow, and, later, of Asst. Surg. K. Ryland, U. S. A. This mean, corrected for the zero error of the instrument, is 23.513 inches, and 42° air temperature, which values probably represent very nearly the mean of the year. I thus found the altitude 6,688 feet—1,791 more than that of Camp Floyd, while the mean difference of elevation between both points, determined in various ways, from very careful simultaneous observations, and from large means, is 1,796 feet. These results agree very satisfactorily, and speak for the correctness of the observations and method. Taking into consideration, moreover, the height of the instruments above the ground, we may assume as well established the altitude of Camp Floyd (parade ground, near headquarters) as 4,860 feet, and of Fort Bridger (parade ground), as 6,656 feet. In these computations, as in the other, the elastic force of the aqueous vapor has not been taken into consideration, but La Place's formula has been made use of, for the reasons stated above.

GENERAL REMARKS IN REGARD TO CAMP FLOYD AND THE UTAH BASIN.

The reading of the barometer at Camp Floyd varied considerably during the different months. The highest monthly mean was observed in January; the lowest in February. A higher atmospheric pressure seems to prevail in the fall and first part of winter; a lower one in the spring and part of summer; but as the observations have not all been made with the same degree of accuracy, and cover too limited a time, it would be unsafe to draw definite conclusions from them. The subjoined table contains the monthly means, the authorities for which I have stated above (namely, myself, Dr. Williams, and Dr. Moore). It also contains the quantities of rain and melted snow at Camp Floyd, taken, from 1858 to 1859, from the records of the Medical Department of the Army, and at Salt Lake City, from March, 1857, to February, 1858, upon the authority of a Mr. W. W. Phelps, a citizen of that place.

Month.	Barometric pressure.			Temperature.			Rain and melted snow, in inches.			
	Year.	Inches, English.	Observer.	Year.	Degrees, Fahrenheit.	Observer.	Observer, Dr. Moore.		Observer, Mr. W. W. Phelps.	
							Year.	Camp Floyd.	Year.	Salt Lake City.
November	1858	25.208	E.	1858	34.0	E.	1858	0.50	1857	2.80
December	1858	25.106	E.	1858	22.0	E.	1858	0.30	1857	5.40
January	1859	25.297	E.	1859	16.2	E.	1859	0.35	1858	0.30
February	1859	25.031	E.	1859	29.9	E.	1859	1.14	1858	1.37
March	1859	25.069	E.	1859	31.9	E.	1859	0.28	1858	0.39
April	1859	25.062	E.	1859	43.6	E.	1859	0.40	1858	0.19
May	1859	25.082	M.	1859	54.7	W.	1859	0.40	1858	0.83
June	1859	25.122	M.	1859	74.7	W.	1859	0.03	1858	1.01
July	1859	25.175	M.	1859	75.0	W.	1859	2.28	1858	0.64
August	1859	25.133	M.	1859	72.1	M.	1859	0.18	1858	0.85
September	1859	25.173	M.	1859	58.4	M.	1859	1.72	1857	0.57
October	1859	25.213	M.	1859	50.7	M.	1859	0.00	1857	1.10
Mean	1 year	25.140			47.0		Total	7.58	Total	15.45

The heaviest precipitation of rain takes place during the fall and winter, but generally every month has some rain, and the climate of Utah does in that respect by no means exhibit the periodicity of the climate of California, and of more southern latitudes.

During the summer months the showers seldom continued any length of time, and frequently only a few drops fell. The precipitation is most copious near high mountains, not only for the same causes which in all countries favor the precipitation of moisture on high mountains, but also, it appears, because the clouds and drops of rain, while sinking through the parched lower strata of the atmosphere, are partly again dissolved into vapor, and thus become less before reaching the bottom of the valleys, unless the rain should happen to be heavy. This is the contrary of what takes place in moister climates, where the quantity of rain frequently increases with every foot of its descent through the air, which is saturated with moisture.

In June we had no rain in the field, but in July numerous short showers occurred, which, in the aggregate, amounted, however, only to 2 inches of rain. At Camp Floyd 2.28 inches were measured in July. I am unable to determine whether the difference in the amount of precipitation between Camp Floyd and Salt Lake City, as exhibited by the above table, is mainly due to the irregularity of the distribution of rain and snow in the different years, or to other causes, although I have no doubt but that the fall of rain and snow is more abundant at Salt Lake City, which is situated at the very foot of the high and wide range of the Wahsatch Mountains, near the most elevated summits of which considerable banks of snow remain unmelted all the year round, although they cannot be said to reach the limit of perpetual snow, and the moister atmosphere of which is indicated by a different vegetation than farther off these mountains near Camp Floyd, and in the other open valleys. In 1857, six feet of snow fell near Salt Lake City; certainly much more than is likely ever to fall at Camp Floyd during a single winter.

Dew falls very rarely in the vast desert valleys and on most of the mountain ranges of Western Utah, in the so-called Great Basin. The scarcity of grass in the valleys, which are mostly covered with a thin growth of *Artemisia* and other desert plants, combined with the great dryness of the atmosphere, which is indicated by the small amount of rain, is not favorable to its formation. On our whole march from Camp Floyd to the Sierra Nevada and back, during May, June, July, and part of August, that is, from the time when it was still snowing occasionally to the time when the greatest heat of the summer was over, we observed dew only on three mornings, and then it was confined to a border of grass of only a few feet in width along the banks of creeks. In Section V of the Geological Report, I have shown that the cause of this great deficiency of moisture is a consequence of the geographical situation and hypsographical character of the country.

The remarkable dryness of the atmosphere influences also its electric condition. We know that dry air is a non-conductor of electricity, while moist air is a conductor. The electricity which is constantly developed in various ways, is, under ordinary circumstances, mostly at once conducted to the earth or diffused in the moist air. In the comparatively moist climate of Western Europe, in Germany, for example, electricity can therefore always be detected in the air by delicate instruments, while even in the Mississippi Valley, in the drier climate of the summer months, frequently not the slightest trace of it is indicated by the same instruments, as I am informed by Dr. Ad. Wislizenus, of Saint Louis, who has lately commenced an interesting series of experiments upon this subject. In the arid climate of Utah the air conducts the electricity still less, and even the parched pulverulent soil appears to become a non-conductor. Thus the electricity is accumulated where it is developed. Not only do woolen clothes, buffalo-robes, and all sorts of peltry, and even the saddle-blankets on the horses become highly charged, but the glass on wood-cased pocket-compasses becomes so electric that the needle adheres to the glass and persistently refuses to work, and the equilibrium cannot be restored by merely touching the glass with the hand. Where thus every part of the instruments, and the body and clothing of the observer are apt to be electric, and the soil and air are non-conductors, all the delicate magnetic observations become exceedingly difficult to take.

I cannot conclude these remarks without mentioning a phenomenon familiar to all the settlers along the foot of the Wahsatch range. During certain seasons, regularly every evening soon after sunset, a wind rises, blowing from the summit of the mountains down the cañons, toward the wide longitudinal valleys at their base. It is by them called cañon-wind, and finds its explanation in the circumstance that in the evening when the other winds generally lull, the radiation of heat of the bare dry soil of the valleys, and consequently the upward movement of the heated air continues for several hours, and the equilibrium is restored by the afflux of colder air from the mountain summits by the channels of the narrow side-valleys, in which the temperature is depressed by the evaporation of their streams, which makes a great deal of heat latent. This phenomenon bears resemblance to the land and sea breezes on the coast.

Another phenomenon of frequent occurrence near Camp Floyd are whirlwinds, which for months may be seen nearly daily traversing Cedar Valley in its longitudinal direction from north to south. They have no great diameter, but considerable height, and may readily be followed with the eye by the high cylindrical column of dust which they raise. When they passed our barometrical station, I observed several times that the mercurial column fell momentarily, and then rose again to its former height; all within the few seconds occupied by the passage of the whirl. I never observed, instrumentally, the quantity of this fall, but it cannot have been less than 0.1 inch, and perhaps it was much larger. The fall of the barometer is partly caused by the upward movement, and thus diminished pressure of the air, of which the height of the column of dust affords a proof, but I explain it principally by the fact that the whirl, being formed by a body of air in violent motion, does not exercise the pressure corresponding to a similar column of air at rest or comparative rest outside the whirl. This is in strict conformity to the laws of pneumatics, and analogous to the laws of the difference of the static and dynamic pressure of fluids. A third cause is to be found in the circumstance that the progressing whirl, imparting its rapid rotary motion to bodies of air before comparatively at rest, tears them off from the main body of the air, which is unable to join in that motion so rapidly as not to exhibit a slight expansion and consequent diminution of the pressure. The causes of the frequent occurrence, and of the regular development of this interesting phenomenon, may be found in the great width and length of the valleys, which are free from any obstruction; in the large quantity of heat radiated from their sparsely-covered and dry soil; in the powerful fluctuations of the atmosphere, caused by the difference of temperature between the bottom of the valleys and the upper regions of the air, and the great amplitude of the daily oscillations of the temperature. Near Camp Floyd, in Cedar Valley, they may be caused directly by the distribution and configuration of the mountains at the northern end of the valley. The winds from the north and northwest, after sweeping over the immense unbroken level of the Salt Lake Valley, when they approach Cedar Valley, are divided into two branches by the mountains which separate Tuilla Valley from the valley of Jordan River. The western branch meets, at the southern end of Tuilla Valley, with the mountain mass of Floyd's Peak, and partly continues into Rush Valley, partly is diverted to the southeast and enters the northwestern extremity of Cedar Valley, across a depression in the O-quirrh Mountains. The eastern branch enters Cedar Valley by various depressions in the much less elevated so-called Traverse Mountains. These different currents, when meeting again, appear to form the whirls whenever the accessory circumstances are favorable.

HYGROMETRICAL CONDITIONS OF THE ATMOSPHERE.

I have already spoken of the smallness of the amount of rain, snow, and dew which falls in Central and Western Utah. Before discussing this subject farther, I will introduce some general remarks for the benefit of the scientific reader.

The formation of vapor in the air is especially dependent upon two conditions, namely, upon the temperature and upon the presence of water. With an unlimited supply of moisture, vapor will be found in proportion to the height of the temperature; but with equal degrees of temperature, more vapor will be formed in districts which abound in water than in those which do not. Hence it follows that the absolute quantity of vapor in the air, other circumstances being the same, is less in the interior of continents than on the seashore. As more vapor is diffused through the air at a high temperature, and as with an increasing heat the water evaporates more and more from the surface of large masses of water and from the moist ground, the quantity of water contained in the form of vapor in the lowest stratum of the air by which we are surrounded will diminish and increase in the course of the day. In climates of moderate humidity, such as Western Europe, the quantity of vapor in the air is generally increased as the temperature rises with the rising of the sun. This, however, only lasts till about 9 a. m., when the ground becomes dryer, and an ascending current of air, occasioned by the strong heating of the surface of the ground, carries the vapor on high, so that the weight of water contained in the lower strata of the air diminishes, although the formation of vapor continues. This diminution continues till toward 4 p. m.; then the quantity of water of the lower strata of the air again increases, because the upwardly-directed current of air ceases to carry away the vapor formed. This increase lasts, however, only until toward 9 p. m., because the decreasing temperature puts a limit to the further formation of vapor. In winter, when the action of the sun is less intense, the state of the case is different. Then there is generally only one maximum of the quantity of water in the air at about 2 p. m., and only the minimum at the time of sunrise. The weight of vapor in the air is, besides, smaller in winter, on account of the lower temperature.

The ratio between the quantity of aqueous vapor which air of a certain temperature is able to dissolve and the quantity which it actually contains, its relative humidity or degree of saturation, is subject to similar changes during the day. The relative humidity is generally smallest about the time of the afternoon minimum of the weight of vapor in the air, and greatest near the hour of the lowest temperature, about or before sunrise. Air of high relative humidity is called damp—it is the reverse of dry air—in which latter moistened objects become rapidly dry. In damp air a further decrease of temperature occasions a precipitation of moisture. Thus dew is formed. It is, however, by no means necessary to the formation of dew that the temperature of the air should sink below the point at which it would be saturated by the vapor present; on the contrary, then, not dew but rain would fall. Dew forms only on objects which, by stronger eradication of heat, become cooled below the temperature of the surrounding air. This difference may amount to from 7 to 25 degrees Fahrenheit.

The same quantity of vapor contained in a certain volume of air exercises a different pressure upon the inclosing vessel, according to its temperature. This tension, or elastic force, can be measured by the barometric column, and the indications of the barometer are partly due to the pressure of the air itself, partly to the pressure of the aqueous vapor diffused through it. The elastic force of vapor in the lowest stratum of the atmosphere also varies during the day with the changing temperature and quantity of weight of vapor in the air.

As the hygrometrical conditions and laws of the atmosphere are still imperfectly known, it is presumed that the remarkable results obtained by this expedition will be acceptable to the friends of meteorology. They throw some light on the climatical conditions of a district which in this, as in most other respects, differs vastly from the Eastern States of the Union. From our observations we cannot deduce complete laws, because the observations could not be continued for long periods at one station, but have mostly been taken for short times only, at numerous different points; but further explorations may complete the results. The observations have been executed with as much care as was possible under the circumstances, and the uniformity of the results, of which the following tables and diagrams afford a proof, appears highly satisfactory and testifies to their relative correctness. Still I do not hesitate to declare that the obstacles in the way of obtaining absolutely correct results, very great at fixed observatories, as those best know who have studied most fully these matters, can scarcely be obviated in the field, where the most simple arrangements can only be used to advantage.

The observations were taken with an August's hygrometer. The dry and wet bulb thermometers were suspended in the shade of the instrument wagon, generally 6 or 7 feet from the ground. I missed very much a suitable casing which would have better secured the observations against vitiating outside influences. The indications of a Mason's hygrometer in which a wide glass tube, closed on top, and fastened between the two thermometers, contained the water for moistening the wet bulb, were found to be very slow, and therefore inaccurate at times when the temperatures changed rapidly; besides, the instrument proved inconvenient for use in the field, and was badly constructed, the two thermometers not reading conformably, and thus making corrections necessary in the records.

The following tables, C and D, exhibit the mean daily oscillation of the elastic force of vapor, and of the relative humidity of the air, at certain stations and seasons, as deduced from our observations. They are graphically represented in the plates, C and D. The full black lines of the diagrams connect the values obtained for each successive hour by direct calculation. Where dotted lines run alongside of the full lines they illustrate the actual result of calculation, inclusive of all irregularities, while then the full lines represent the values which I am led to consider as the means unimpaired by the abnormal oscillations produced by irregular rains, high winds, and similar casualties. In the tables C and D, the values are given only for the hours during which observations have been taken. In other subsequent tables I have given the values obtained for the hours of the night, by interpolation, which are also graphically represented on the diagrams by dotted lines. They were obtained by drawing, in the diagrams of the oscillations of temperature, of the force of vapor, and of the relative humidity, separately and independently of each other, the curves for the hours of the night, such as they appeared to be, required under the circumstances. Then I calculated from two of the thus-obtained values the third, and represented it also on the diagrams. If the discrepancy between the first and second values was beyond the limits of the differences found to exist between the means of the computations of the single observations and the values computed from the means of these observations at the actually observed hours, then I critically examined the diagrams and changed them accordingly, until all the requirements appeared to be fulfilled. I am confident that they will be found to agree very closely with the results of observations which in future may be made in this line. In computing, I have made use of the meteorological and physical tables prepared for the Smithsonian Institution by Prof. A. Guyot, second edition, particularly of Tables B, VI, VII, IX, and X, which are deduced from Regnault's formula and the values obtained by him in his famous investigations on the vapor, instituted by order of the French government. In many instances I could not make use of the tables directly, because they do not extend to the quite abnormal extremes which my observations exhibit. I then had to apply directly the formula. The results of all the single computations will be found in the records of meteorological observations accompanying the report. The means in the following tables, C and D, were calculated without making the slightest discretionary corrections in the single observations, because I consider it impossible correctly to estimate the abnormal influences exercised upon the values by irregular changes of wind and weather, and that it is best to leave them to be balanced against each other.

C.—*Table of daily oscillations of the force of vapor, in inches (English), of the mercurial column.*

Hour.	I.	II.		III.	IV.		V.	VI.	VII.		VIII.
		Observed.	Corrected.		Observed.	Corrected.			Observed.	Corrected.	
6 a. m	0.609	0.332	0.332	0.100	0.144	0.144	0.270	0.118	0.289	....	5.20 a. m. 0.125
7 a. m	.614	.353	.346	....	.158	.157	.280	....	.300	....	....
8 a. m	.627	.349	.357	....	.169	.170	.290	....	.317	....	....
9 a. m	.654	.362	.366	.057	.180	.182	.297	.172	.323	....	.115
10 a. m	.679	.370	.370	....	.190	.190	.294	....	.303	....	....
11 a. m	.690	.364	.364	....	.173	.181	.288	....	.275	....	....
12 m	.680	.329	.336	.103	.177	.172	.282	.097	.224	....	.106
1 p. m	.670	.340	.330	....	.159	.164	.273	....	.181	....	....
2 p. m	.637	.322	.327	....	.160	.156	.258	....	.202	....	....
3 p. m	.622	.348	.336	.086	.151	.150	.230	.048	.240	....	.064
4 p. m	.612	.353	.348	....	.143	.146	.196	....	.246	....	....
5 p. m	.605	.339	.361	....	.154	.142	.162	....	.243	....	....
6 p. m	.602	.385	.372	.104	.138	.139	.140	.057	.240	0.235	.041
7 p. m	.611	.357	.368	....	.138	.138	.172	....	.229	.223	....
8 p. m	.617	.342	.360	....	.143	.143	.175	....	.203	....	....
9 p. m	.625	.363	.351	.086	.153	.152	.185	.102	.193	....	.057
10 p. m	.625	....	....	....	....	....	....	....	....	....	....

D.—*Table of daily oscillations of the relative humidity. Saturation* = 100.

Hour.	I.	II.		III.		IV.	V.		VI.	VII.		VIII.
		Observed.	Corrected.	Observed.	Corrected.		Observed.	Corrected.		Observed.	Corrected.	
6 a. m	81.3	75.2	75.0	37.0	37.0	76.0	64.0	....	41.5	51.8	....	5.20 a. m. 59.0
7 a. m	75.0	66.5	66.5	....	25.5	69.5	57.0	....	....	42.7	....	....
8 a. m	70.4	51.5	56.0	....	16.5	63.0	49.0	....	....	34.7	....	....
9 a. m	66.6	49.5	49.5	9.0	11.5	57.0	41.0	....	21.5	29.2	....	22.0
10 a. m	62.3	44.7	44.0	....	10.0	51.0	30.0	....	....	23.0	....	....
11 a. m	57.8	38.2	38.0	....	9.5	43.0	25.0	....	....	18.7	....	....
12 m	52.0	31.2	33.5	11.5	9.0	39.0	21.0	....	7.5	15.2	....	14.0
1 p. m	49.3	31.0	31.0	....	9.5	37.0	19.0	....	....	11.4	....	....
2 p. m	46.7	30.0	30.0	....	10.0	35.0	22.0	17.0	....	13.4	....	....
3 p. m	45.9	33.7	31.5	10.7	10.7	34.0	16.3	16.0	3.5	15.6	....	7.7
4 p. m	45.2	33.2	33.0	....	12.7	35.0	15.3	15.0	....	17.7	....	....
5 p. m	47.7	34.5	36.0	....	14.7	37.0	17.7	14.0	....	18.6	....	....
6 p. m	50.2	43.2	40.0	16.7	16.7	40.0	14.0	14.5	7.0	22.2	20.0	5.3
7 p. m	60.3	46.2	46.0	....	18.8	46.0	22.0	19.0	....	23.7	21.0	....
8 p. m	68.4	56.2	56.0	....	20.9	52.0	25.3	25.0	....	21.9	22.0	....
9 p. m	74.6	66.2	66.0	23.0	23.0	60.0	33.0	33.0	22.5	23.8	....	15.0
10 p. m	78.9	....	....	....	....	....	....	....	....	....	....	....

No. I C and D was deduced from 11 days' observations at Fort Kearney, Nebraska, from June 19 to 30, 1858, at an elevation of 2,200 feet above the level of the sea.

The mean temperature was 77°.5 Fahrenheit. The mean force of vapor was 0.628 inch; the relative humidity, 68.4, and the mean weight of vapor in one cubic foot of air, 6.75 grains troy. (See Table E.) No. I C and D corresponds to No. I B, and very nearly also to No. II A, which may be considered as forming together one set. It rained on five occasions altogether during 28 hours, but the aggregate quantity of rain was only 1.40 inches. Dew was observed on 3 mornings. Of the 12 nights which this mean includes sheet-lightning was observed on 7, which on one occasion terminated in a thunder-storm, of which there were two. The cloudiness of the sky between the hours of 6 a. m. and 10 p. m. averaged 3.66, the whole sky being 10, and, including the hours of the night by interpolation, 3.35. The clouds were mostly cirro-cumuli, or cirro-stratus, except when it rained. The 190 hourly observations of the wind during that time, between 5 a. m. and 10 p. m., give the following results, the strength being expressed by the numbers from 0 to 10:

	Per cent.	Av. force.		Per cent.	Av. force.
South wind	32.1	4.8	Northeast wind	1.1	1.5
South-southeast wind	30.0	4.4	North-northeast wind	1.1	1.5
Southeast wind	12.6	3.7	North wind	0.5	1.0
East-southeast wind	4.7	1.8	Southwest wind	0.5	5.0
East wind	2.1	2.0	South-southwest wind	2.1	5.0
East-northeast wind	2.1	1.7	Calmness	11.1	0.0

From north-northwest and west-southwest no wind occurred during this time. The average force of the wind, including the calms, was 3.65, exclusive of the night. The only slight discretionary correction of the obtained mean values was made in C at 5 p. m. and 6 p. m., as indicated in the diagram, where an evident irregularity occurred, probably caused by some abnormal change in the atmosphere, rain-storm, or the like.

No. II C and D was deduced from 4 days' observations taken at Fort Laramie, Nebr., from July 30 to August 3, 1858, at an elevation of about 4,470 feet above the level of the sea. The mean temperature of these days was 67°.0 Fahrenheit; the mean force of vapor was 0.344; the relative humidity, 57.0; the mean weight of vapor in 1 cubic foot of air, 3.78 grains troy. Nos. II C and D correspond to No. II B and No. II A; they form altogether one set. It had thundered, and rained a few drops, shortly before the first observation was taken, and it rained twice afterward, for a few moments; but the average quantity of rain was scarcely 0.01 inch. Dew was observed every morning near the river. On 2 of the evenings sheet-lightning was observed, and once distant thunder. Thunder-storms are numerous in that neighborhood and season. The cloudiness of the sky between the hours of 6 a. m. and 9 p. m. averaged 4.62, and, including interpolations for the night, 4.37, the clouds being mostly cumuli. This increased cloudiness compared with Fort Kearney, while the relative humidity is, on the contrary, less, is a consequence of the neighborhood of the highly-elevated summits of the Rocky Mountains, the lower temperature and comparative moistness of which favors the formation of clouds, which, however, dissolve again when they sink into the lower regions of the air. Of the 64 observations of the wind during these 4 days, between 6 a. m. and 9 p. m.—

24 showed easterly winds, including N. E. and S. E., with average force of 2.4.
14 showed westerly winds, including N. W. and S. W., with average force of 3.0.
13 showed northerly winds, including N. N. W. and N. N. E., with average force of 2.0.
3 showed southerly winds, including S. S. E. and S. S. W., with average force of 2.0.
10 showed perfect calmness.

The average force of wind, including the calms, was 2.0. The wind shifted continually, and this, in connection with the peculiar situation of Fort Laramie, at the foot of the high range of the Rocky Mountains, and bordering on the vast arid plains, in consequence of which the shifting wind at once brings currents of air of a quite different temperature and degree of moisture, makes the observed values of No. II C and D somewhat irregular, which irregularity is increased by the influence of the two thunder-storms. Some discretionary corrections have, therefore, been required.

No. III C and D was deduced from tri-hourly observations, taken at Fort Bridger, Utah, from September 2 to September 5, 1858, at an elevation of 6,616 feet above the level of the sea. The mean temperature during these days was 59°.0 Fahrenheit; the mean force of vapor only 0.088 inch; the relative humidity, 21.6; and the mean weight of vapor in 1 cubic foot of air, 0.98 grain troy. Nos. I C and D do not exactly correspond to No. III B and No. IV A, which were taken a fortnight later, under somewhat different circumstances. Neither rain nor dew fell, but a few hours after the close of the observations a rain-storm set in, which gradually brought on snow. The cloudiness of the sky between the hours of 6 a. m. and 9 p. m. averaged 2.33, mostly cirri, and, including the hours of the night, by interpolation, 1.75. Western winds were prevailing, with an average force of 4, coming from the arid regions of the Great Basin. A very slight discretionary correction has only been made in No. III D.

No. IV C and D was deduced from 19 days' observations taken at Camp Floyd, Utah, from April 4 to April 23, 1859, at an elevation of 4,860 feet above the level of the sea. The mean temperature was 42°.0 Fahrenheit; the mean force of vapor, 0.155 inch; the relative humidity, 57.0; and the mean weight of vapor in 1 cubic foot of air, 1.68 grains troy. No. IV C and D correspond to No. IV B, and very nearly also to No. V A, which together form one set. During the time of these observations it snowed on nine occasions and rained on one, in an aggregate 22 hours, of which 10 hours were on the 9th, the remainder on the 10th, 11th, 12th, and 13th. The whole precipitation probably did not exceed 0.5 inch of water. The cloudiness of the sky between the hours of 6 a. m. and 9 p. m. averaged 5.37, and, including the hours of night, by interpolation, 5.16. The clouds were mostly cumuli. During 18 hours out of 100 the sky was cloudless. This rather large cloudiness has its cause in the altitude of the surrounding mountain ranges, which were still extensively covered with snow, while the temperature in the deserts to the west was already high and the evaporation strong. The 312 hourly observations of the wind during that time, between 6 a. m. and 9 p. m., give the following results:

North, north-northeast, and northeast winds, 33.3 per cent., with an average force of 2 8.
South and southeast winds, 12.8 per cent., with an average force of 3.4.
Southwest and west-southwest winds, 9.3 per cent., with an average force of 4.0.
West and west-northwest winds, 8.3 per cent., with an average force of 2.0.
Northwest and north-northwest winds, 6.1 per cent., with an average force of 1.8.
East, east-southeast, and southeast winds, 10.3 per cent., with an average force of 2.3
Perfect calmness, 19.9 per cent.

This table of winds will be better understood and appreciated if I mention that the north and northeast winds pass longitudinally over Cedar Valley, the valley in which Camp Floyd is situated, coming over low hills from the Salt Lake Valley. The south and south-southeast winds, and the southwest and west-southwest winds, the strongest winds, pass also more or less longitudinally over the valley, the former from the valleys at the base of the Wahsatch range; the latter over low mountains, from the vast deserts in the direction of Sevier Lake. The west and west-northwest winds pass across the valley, entering it from Rush Valley. They acquire less force because they are intercepted, in their forward and backward direction, by high ranges of mountains. For the same reason the eastern winds are not very strong. The northwest and north-northwest winds are still less numerous and weaker, because they find still more obstructions. The average force of wind, including the calms, was 2.27, and, including the hours of the night, by interpolation, probably 1.84. We may account for this comparatively small force by the circumstance that the valley is surrounded by high mountain ranges which break the force of the currents in the lower strata of the atmosphere. Some very strong squalls were felt, however, lasting for several hours.

In No. IV D not the least corrections have been found necessary; but in No. IV C some small corrections have been required, in consequence of the unsettled state of the weather.

No. V C and D was deduced from 3 days' observations taken at Camp Floyd, Utah, from August 6 to August 9, 1859. The mean temperature of these days was 69°.5 Fahrenheit; the mean force of vapor was 0.238 inch; the mean relative humidity, 38.0, and the mean weight of vapor in 1 cubic foot of air, 2.59 grains troy. No. V C and D correspond to No. V B, and very nearly to No. VI A, which may be considered as forming together one set. No rain nor dew fell. The cloudiness of the sky between the hours of 6 a. m. and 9 p. m. averaged only 0.56, but if we make interpolations for the hours, probably to 0.62. The average force of the wind, including the calms, between 6 a. m. and 9 p. m. was 1.7; fully one-half of the observations showed northerly winds, with an average force of 2.5; 23 per cent. were calms, and the remainder southerly and westerly winds. No. V C did not require the slightest corrections, but for No. V D a few slight corrections appeared to be desirable, and have been indicated.

No. VI C and D was deduced from 3 days' hourly observations taken at Camp Floyd, from September 15 to 18. The mean temperature was 64°.7 Fahrenheit; the mean force of vapor was 0.103 inch; the mean relative humidity was 21.9; the mean weight of vapor in one cubic foot of air, 2.67 grains troy. Nos. VII C and D correspond to No. VII B and No. X A, with which they form one set. The weather was fine; no rain nor thunder-storms occurred. No dew was observed at camp, but was formed most likely on the meadows below. The cloudiness of the sky between the hours of 6 a. m. and 9 p. m. averaged 1.6; and including interpolations for the night, probably 1 3. The clouds were mostly cumulo-cirri and some cumulo-stratus; over half of the time the sky was perfectly cloudless. The average force of the wind between 6 a. m. and 9 p. m. was 1.6 including the calms, which lasted 18.5 per cent. of the time; 23.8 per cent. were north and northeast winds, passing up the valley with an average force of 1.7; 38.5 per cent. were south and southwest winds, blowing down the valley with an average force of 2.1; 11.3 per cent. were west and northwest winds, passing down a narrow cañon in the Sierra Nevada with a force of 2.4; only 7.9 per cent. were east winds, passing up that cañon with an average force of 1.1.

The computed values of No. VII D appeared to require a slight correction at the hours of 6 and 7 p. m., and then No. VII C was changed slightly to make it correspond better to D; but it is very likely that the uncorrected values are preferable, the apparent irregularity being caused by the peculiar situation of the station.

No. VIII C and D was deduced from 3 days' tri-hourly observations taken from May 29 to June 2, 1859, in Woodruff Valley, one of the arid deserts of the interior of Utah, at an elevation of about 6,000 feet above the level of the sea. The mean temperature of these days was 55°.0 Fahrenheit; the mean force of vapor was only 0.093 inch; the mean relative humidity was 29.1, and the mean weight of vapor in one cubic foot of air was 1.08 grains troy. Nos. VIII C and D correspond very nearly, although not exactly, to No. VIII B. They give the unaltered means of the computed values. The cloudiness of the sky averaged 1.4, or, including interpolations for the night, 1.3. The force of the wind averaged 2.4, while its direction changed between north, south, and west.

After having thus stated the particulars in regard to each of the above tables I will give a more comprehensive view of the results, and have for that purpose arranged the Table E. It is based upon the Tables B, C, and D, but contains interpolations for all the hours when no direct observations have been taken, and corresponds mostly to the same diagrams. The columns for temperature, force of vapor, and relative humidity contain the means of direct observations, or of computations from the single observations. The columns headed force of vapor at saturation, and weight of vapor at saturation, are deduced from the columns of temperature with the aid of Regnault's tables. The columns headed weight of vapor in one cubic foot of air, are deduced from the mean values of temperature and relative humidity. Their values would probably have been slightly different if the weight of vapor could have been deduced for each single observation, as it has been done with the force of vapor and relative humidity, but that would have required more time than I had at my disposition. The column headed means contains the means of the values for the single hours as given in the tables.

E.—*Table of the hourly oscillations of temperature and hygrometric conditions.*

	Hours.																								
	0	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	12 m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Means.
Fort Kearney, Utah, in June.																									
Temperature, degrees Fahrenheit	70.5	69.7	69.0	68.3	67.7	67.7	69.5	72.7	76.0	79.5	82.7	85.0	86.7	88.0	88.7	88.7	88.0	87.0	84.5	79.8	76.2	74.2	72.8	71.5	77.5
Force of vapor in inches, English, of mercury	.620	.617	.614	.610	.607	.606	.609	.614	.627	.654	.679	.690	.680	.670	.637	.622	.612	.605	.602	.611	.617	.625	.625	.623	0.628
Force of vapor at saturation	.745	.725	.708	.692	.671	.678	.721	.803	.897	1.006	1.117	1.203	1.270	1.323	1.353	1.353	1.340	1.282	1.184	1.016	.903	.845	.806	.771	0.975
Relative humidity, per cent	85.3	87.7	89.0	89.5	89.0	86.0	81.3	75.0	70.4	66.0	62.3	57.8	52.0	49.3	46.7	45.9	45.2	47.7	50.2	60.3	68.4	74.6	78.9	82.5	68.4
Weight of vapor in 1 cubic foot of air at saturation, grains troy	8.12	7.92	7.74	7.57	7.42	7.42	7.86	8.71	9.67	10.78	11.90	12.76	13.43	13.96	14.25	14.25	13.96	13.55	12.57	10.55	9.73	9.14	8.74	8.39	10.43
Weight of vapor in 1 cubic foot of air in grains troy	6.93	6.94	6.89	6.77	6.60	6.38	6.39	6.54	6.81	7.18	7.41	7.37	6.98	6.88	6.61	6.49	6.31	6.46	6.31	6.36	6.66	6.82	6.90	6.92	6.75
Fort Laramie, Nebr., first days of August.																									
Temperature, degrees Fahredheit	55.0	54.0	53.3	52.7	52.0	51.8	53.2	58.8	65.3	71.5	75.7	78.7	80.7	82.2	83.0	82.5	81.5	79.5	76.0	71.0	64.0	60.0	57.7	56.2	67.0
Force of vapor, inches, English, of mercury	.331	.326	.323	.321	.320	.322	.332	.346	.357	.366	.370	.364	.336	.330	.327	.336	.348	.361	.372	.368	.360	.351	.343	.336	0.344
Force of vapor at saturation	.433	.418	.407	.398	.388	.385	.406	.496	.624	.774	.888	.980	1.047	1.099	1.128	1.110	1.074	1.006	.897	.758	.596	.518	.477	.452	0.698
Relative humidity, per cent	78.2	80.0	81.0	82.0	83.0	84.0	75.0	66.5	56.0	49.5	44.0	38.0	33.5	31.0	30.0	31.5	33.0	36.0	40.0	46.0	56.0	66.0	72.0	75.8	57.0
Weight of vapor at saturation	4.86	4.70	4.58	4.49	4.38	4.35	4.57	5.53	6.86	8.39	9.58	10.52	11.19	11.71	12.00	11.82	11.47	10.78	9.67	8.25	6.57	5.76	5.33	5.06	7.60
Weight of vapor in 1 cubic foot, grains	3.80	3.76	3.71	3.68	3.64	3.66	3.43	3.68	3.84	4.15	4.22	4.00	3.75	3.63	3.60	3.72	3.78	3.88	3.87	3.80	3.68	3.80	3.84	3.86	3.78
Camp Floyd, Utah, in April.																									
Temperature, degrees Fahrenheit	35.0	33.8	32.5	31.2	30.0	29.0	30.3	35.0	39.7	44.0	48.3	51.5	53.5	55.0	55.5	55.0	53.7	51.7	47.7	43.0	40.7	39.0	37.6	36.3	42.0
Force of vapor, inches	.155	.151	.147	.143	.141	.139	.144	.157	.170	.182	.190	.181	.172	.164	.156	.150	.146	.142	.139	.138	.143	.152	.156	.157	0.155
Force of vapor at saturation	.204	.194	.185	.175	.167	.160	.169	.204	.245	.288	.339	.381	.410	.433	.441	.433	.413	.384	.331	.277	.254	.236	.226	.214	0.282
Relative humidity, per cent	73.0	75.0	76.5	77.3	77.7	78.0	76.0	69.5	63.0	57.0	51.0	43.0	39.0	37.0	35.0	34.0	35.0	37.0	40.0	46.0	52.0	60.0	66.0	70.0	57.0
Weight of vapor at saturation	2.38	2.27	2.17	2.06	1.97	1.89	1.99	2.38	2.83	3.31	3.85	4.31	4.62	4.86	4.94	4.86	4.68	4.34	3.77	3.19	2.93	2.76	2.62	2.50	3.23
Weight of vapor, grains	1.74	1.71	1.66	1.59	1.53	1.48	1.51	1.65	1.78	1.88	1.96	1.85	1.80	1.80	1.73	1.65	1.63	1.61	1.51	1.47	1.53	1.66	1.73	1.75	1.68
Camp Floyd, Utah, first part of August.																									
Temperature, degrees Fahrenheit	57.6	56.1	54.5	53.2	52.5	52.0	55.0	59.5	65.0	70.5	76.0	81.0	85.0	87.5	88.0	88.0	87.5	84.5	80.5	74.5	68.0	64.0	61.2	59.2	69.5
Force of vapor, inches	.228	.240	.251	.258	.262	.266	.270	.280	.290	.297	.294	.288	.282	.273	.258	.230	.196	.162	.140	.172	.175	.185	.200	.215	0.238
Force of vapor at saturation	.476	.451	.425	.406	.395	.388	.433	.509	.617	.745	.897	1.057	1.203	1.303	1.323	1.323	1.303	1.184	1.040	.853	.685	.596	.540	.503	0.777
Relative humidity, per cent	51.0	56.0	60.0	64.0	67.0	68.0	64.0	57.0	49.0	41.0	30.0	25.0	21.0	19.0	17.0	16.0	15.0	14.0	14.5	19.0	25.0	33.0	40.0	46.0	38.0
Weight of vapor at saturation	5.31	5.04	4.78	4.57	4.46	4.38	4.86	5.66	6.79	8.12	9.67	11.29	12.76	13.75	13.96	13.96	13.75	12.57	11.12	9.23	7.49	6.57	5.99	5.60	8.40
Weight of vapor, grains	2.71	2.83	2.87	2.92	2.99	2.98	3.11	3.23	3.33	3.33	2.90	2.82	2.68	2.61	2.37	2.23	2.06	1.76	1.61	1.75	1.87	2.17	2.40	2.58	2.59
Camp Floyd, Utah, middle of September.																									
Temperature, degrees Fahrenheit	50.0	48.0	46.0	44.5	43.0	42.5	43.0	50.5	62.0	73.0	81.0	85.5	88.5	90.5	90.8	89.0	85.5	79.5	71.5	64.8	60.4	57.0	54.8	52.2	64.7
Force of vapor in inches, English, of mercury	.113	.114	.114	.114	.114	.114	.118	.140	.160	.172	.152	.123	.097	.096	.060	.048	.043	.044	.057	.077	.092	.102	.109	.112	0.103
Force of vapor at saturation	.361	.335	.311	.294	.277	.272	.277	.367	.556	.811	1.057	1.222	1.344	1.432	1.446	1.366	1.222	1.006	.771	.613	.523	.465	.430	.391	0.715
Relative humidity, per cent	32.3	35.0	37.2	39.5	41.0	42.0	41.5	36.0	28.0	21.5	16.5	12.0	7.5	5.0	4.0	3.5	3.5	4.5	7.0	12.0	18.0	22.5	26.0	29.0	21.9
Weight of vapor in 1 cubic foot of air, at saturation, grains troy	4.09	3.81	3.55	3.37	3.19	3.13	3.19	4.16	6.15	8.80	11.29	12.95	14.17	15.03	15.16	14.38	12.95	10.78	8.39	6.75	5.83	5.20	4.83	4.41	7.69
Weight of vapor in 1 cubic foot of air, grains	1.32	1.33	1.32	1.33	1.31	1.32	1.32	1.50	1.72	1.80	1.86	1.55	1.06	0.75	0.61	0.50	0.45	0.49	0.59	0.81	1.05	1.17	1.26	1.28	1.[illegible]6
Genoa, Carson Valley, Nevada, in June.																									
Temperature, degrees Fahrenheit	66.2	63.9	61.5	59.3	57.1	57.3	62.3	69.3	76.8	82.8	87.3	90.3	92.3	93.3	93.3	92.3	90.6	87.3	81.3	77.8	75.3	73.1	70.9	68.5	76.3
Force of vapor, inches, English	.222	.240	.255	.266	.273	.280	.289	.300	.317	.323	.303	.275	.224	.181	.202	.240	.246	.243	.235	.223	.203	.193	.193	.205	0.248
Force of vapor at saturation	.644	.594	.546	.505	.467	.470	.562	.716	.921	1.121	1.294	1.423	1.515	1.563	1.563	1.515	1.436	1.294	1.067	.952	.876	.814	.756	.696	0.971
Relative humidity, per cent	35.0	41.0	47.8	54.0	61.0	60.0	57.8	42.7	34.7	29.2	23.0	18.7	15.2	11.4	13.4	15.6	17.7	18.6	20.0	21.0	22.0	23.8	26.5	30.0	30.6
Weight of vapor at saturation	7.07	6.55	6.05	5.62	5.22	5.26	6.22	7.81	9.92	11.93	13.67	14.94	15.85	16.32	16.32	15.85	15.08	13.67	11.40	10.23	9.46	8.82	8.23	7.62	10.38
Weight of vapor	2.47	2.69	2.89	3.04	3.18	3.15	3.22	3.34	3.44	3.48	3.14	2.79	2.41	1.86	2.19	2.47	2.67	2.54	2.28	2.15	2.08	2.10	2.18	2.28	2.67

Woodruff Valley, Utah, end of May.																								
Temperature, degrees Fahrenheit	41. 7	38. 6	35. 8	33. 1	31. 4	31. 8	36. 0	45. 0	57. 0	63. 6	67. 0	69. 5	71. 7	73. 7	75. 5	76. 4	75. 0	71. 5	66. 5	60. 0	55. 0	51. 0	48. 1	44. 8	55. 0
Force of vapor, inches, English	. 108	. 117	. 123	. 127	. 129	. 129	. 125	. 122	. 119	. 115	. 112	. 109	. 106	. 093	. 078	. 064	. 053	. 045	. 041	. 038	. 041	. 057	. 078	. 095	0. 093
Force of vapor at saturation	. 264	. 234	. 210	. 189	. 177	. 180	. 212	. 299	. 465	. 588	. 662	. 721	. 776	. 831	. 882	. 909	. 868	. 771	. 650	. 518	. 433	. 374	. 336	. 297	0. 494
Relative humidity, per cent	41. 0	50. 0	59. 0	67. 0	73. 0	72. 0	59. 0	43. 0	31. 0	22. 0	18. 5	16. 0	14. 0	11. 9	9. 8	7. 7	6. 9	6. 1	5. 3	6. 0	9. 0	15. 0	23. 0	32. 0	29. 1
Weight of vapor at saturation	3. 04	2. 72	2. 45	2. 22	2. 08	2. 11	2. 47	3. 43	5. 20	6. 49	7. 25	7. 86	8. 44	9. 00	9. 52	9. 79	9. 37	8. 39	7. 14	5. 76	4. 86	4. 23	3. 82	3. 40	5. 46
Weight of vapor	1. 25	1. 36	1. 45	1. 48	1. 52	1. 52	1. 46	1. 47	1. 61	1. 43	1. 34	1. 26	1. 18	1. 07	0. 93	0. 75	0. 65	0. 51	0. 38	0. 35	0. 44	0. 64	0. 88	1. 09	1. 08

For comparison with and better appreciation of Table E, I subjoin Table F, which shows the daily oscillation of temperature, force of vapor, relative humidity, and weight of vapor at Philadelphia, for the same months for which such data have been presented in E. I have compiled it from the summary of results of the hourly meteorological observations taken at the Girard College, Philadelphia, in 1842, 1843, 1844, and first half of 1845, by Prof. A. D. Bache, as published by order of Congress. From these tables I have compiled directly the values for temperature and force of vapor, and from these I have deduced the values for relative humidity and weight of vapor. For the additional computations, which I had thus to make, I made use of the tables based upon the results obtained at the Greenwich observatory, which differ a little, and are not quite as reliable as those of Regnault, because the original computations of the force of vapor had been based upon these English values, and the application of the French tables on my part would have vitiated the results.

F.—*Table of the hourly oscillations of temperature and hygrometric conditions, at Philadelphia.*

	Hours.																								
	0	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	12 m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Means.
January.																									
Temperature, degrees Fahrenheit	31.2	30.6	30.4	30.1	29.9	29.6	29.3	29.1	29.5	30.9	32.6	34.1	35.4	36.6	37.3	37.4	37.1	35.6	34.7	33.8	33.1	32.5	31.9	31.4	32.7
Force of vapor, inches, English, mercury	.169	.165	.165	.163	.164	.162	.159	.159	.159	.161	.165	.168	.170	.174	.178	.180	.179	.181	.181	.179	.175	.173	.170	.169	0.170
Force of vapor at saturation	.194	.190	.188	.186	.185	.183	.181	.180	.182	.192	.204	.215	.225	.235	.240	.241	.239	.227	.219	.213	.207	.203	.198	.195	0.205
Relative humidity, per cent	87	87	88	88	89	89	88	88	87	84	81	78	76	74	74	75	75	80	83	84	85	85	86	87	83.2
Weight of vapor in 1 cubic foot of air at saturation, grains troy	2.31	2.26	2.24	2.22	2.20	2.18	2.16	2.15	2.17	2.28	2.42	2.54	2.66	2.76	2.83	2.84	2.81	2.67	2.59	2.51	2.46	2.41	2.36	2.32	2.43
Weight of vapor in 1 cubic foot of air	2.01	1.97	1.97	1.95	1.96	1.94	1.90	1.89	1.89	1.92	1.96	1.98	2.02	2.04	2.09	2.13	2.11	2.14	2.15	2.11	2.09	2.05	2.03	2.02	2.01
April.																									
Temperature, degrees Fahrenheit	47.6	46.7	45.9	45.5	45.0	44 8	45.3	46.8	49.0	51.2	53.3	55.1	56.8	58.1	59.0	59.4	59.4	58.7	57.3	54.4	52.3	50.9	49.6	48.4	51.7
Force of vapor, inches, English	.290	.287	.282	.281	.277	.277	.278	.285	.292	.297	.306	.310	.318	.324	.325	.324	.323	.322	.319	.314	.305	.298	.288	.285	0.300
Force of vapor at saturation	.344	.333	.324	.320	.315	.312	.318	.335	.361	.389	.418	.444	.470	.491	.506	.513	.513	.501	.478	.434	.404	.385	.368	.354	0.401
Relative humidity, per cent	84	86	87	88	88	89	87	85	81	76	73	72	68	66	64	63	63	64	67	72	75	77	78	81	76.4
Weight of vapor at saturation	3.96	3.84	3.75	3.70	3.64	3.62	3.68	3.86	4.14	4.45	4.75	5.04	5.31	5.53	5.69	5.76	5.76	5.64	5.39	4.92	4.60	4.41	4.22	4.06	4.57
Weight of vapor, grains	3.33	3.30	3.26	3.26	3.20	3.22	3.20	3.28	3.35	3.38	3.47	3.63	3.61	3.65	3.64	3.63	3.63	3.61	3,61	3.54	3.45	3.40	3.29	3.29	3.43
June.																									
Temperature, degrees Fahrenheit	63.2	62.6	62.0	61.3	60.8	61.1	62.8	65.2	67.6	69.6	71.2	72.8	74.1	75.4	75.9	76.1	76.2	75.3	74.0	71.6	68.3	66.6	65.4	64.2	68.5
Force of vapor, inches, English	.520	.513	.508	.503	.500	.498	.513	.530	.542	.551	.556	.554	.560	.564	.572	.568	.566	.565	.568	.565	.547	.543	.535	.531	0.540
Force of vapor at saturation	.582	.570	.559	.546	.537	.543	.574	.621	.672	.717	.756	.795	.830	.865	.879	.885	.887	.862	.827	.766	.688	.651	.626	.601	0.702
Relative humidity, per cent	89	90	91	92	93	92	89	85	81	77	74	70	67	65	65	64	64	66	69	74	80	83	85	88	78.9
Weight of vapor at saturation	6.51	6.37	6.25	6.12	6.02	6.08	6.41	6.91	7.44	7.90	8.30	8.71	9.07	9.43	9.57	9.63	9.66	9.40	9.04	8.40	7.60	7.21	6.95	6.69	7.74
Weight of vapor, grains	5.79	5.73	5.69	5.63	5.60	5.59	5.70	5.87	6.03	6.08	6.14	6.10	6.08	6.13	6.22	6.16	6.18	6.20	6.24	6.22	6.08	5.98	5.91	5.89	5.97
August.																									
Temperature, degrees Fahrenheit	67.1	66.5	66.0	65.9	65.3	64.9	65.5	67.3	69.7	71.9	73.8	75.6	76.7	77.4	78.3	78.4	78.1	77.5	76.0	73.7	71.4	70.1	69.0	68.2	71.4
Force of vapor, inches, English, of mercury	.600	.592	.587	.582	.579	.575	.584	.607	.626	.638	.645	.650	.646	.654	.659	.652	.650	.650	.658	.648	.640	.631	.623	.614	0.625
Force of vapor at saturation	.661	.648	.638	.636	.623	.615	.628	.666	.720	.773	.822	.871	.902	.922	.949	.952	.943	.925	.882	.819	.761	.729	.704	.686	0.770
Relative humidity per cent	91	91	92	92	93	93	93	91	87	83	78	75	72	71	69	68	69	70	75	79	84	87	88	90	82.5
Weight of vapor in 1 cubic foot of air at saturation, grains troy	7.32	7.19	7.08	7.06	6.93	6.85	6.97	7.37	7.93	8.47	8.98	9.48	9.80	10.01	10.28	10.31	10.22	10.04	9.60	8.96	8.35	8.02	7.76	7.59	8.44
Weight of vapor in 1 foot of air, grains	6.66	6.54	6.51	6.50	6.44	6.37	6.48	6.71	6.90	7.03	7.00	7.11	7.06	7.11	7.09	7.01	7.05	7.03	7.20	7.08	7.01	6.98	6.83	6.83	6.86
September.																									
Temperature, degrees Fahrenheit	60.5	60.4	60.0	59.5	59.2	59.0	59.0	60.7	63.2	65.4	67.4	69.3	70.5	71.5	72.2	72.7	72.1	71.2	69.0	66.7	64.4	63.2	62.0	61.3	65.0
Force of vapor, inches, English	.495	.490	.487	.483	.477	.476	.477	.490	.499	.511	.517	.522	.525	.524	.532	.53	.534	.539	.538	.523	.509	.503	.492	.482	0.507
Force of vapor at saturation	.532	.530	.523	.515	.509	.506	.506	.536	.582	.626	.668	.711	.739	.763	.781	.792	.778	.756	.704	.653	.605	.582	.559	.546	0.625
Relative humidity, per cent	93	92	93	94	94	94	94	91	86	82	77	73	71	69	68	67	69	71	76	80	84	86	88	88	82.5
Weight of vapor at saturation	5.96	5.95	5.87	5.78	5.73	5.69	5.69	6.00	6.49	6.95	7.39	7.83	8.12	8.37	8.55	8.68	8.53	8.30	7.76	7.23	6.74	6.49	6.25	6.12	6.94
Weight of vapor, grains	5.54	5.47	5.46	5.43	5.39	5.35	5.35	5.46	5.58	5.70	5.69	5.72	5.77	5.78	5.81	5.82	5.88	5.89	5.90	5.78	5.66	5.58	5.50	5.50	5.63

The hourly variations of temperature, as they are exhibited in the above tables and diagrams, afford a subject of much interesting speculation. In examining them, we notice at once how much the time of the daily maximum is variable, according to season and locality; but still more striking is the great difference of amplitude, and the more gradual or abrupt ascent and descent of the curves. My object is to present the data obtained by our exploration, and not to enter into an elaborate discussion. I will therefore confine myself merely to point out a few of the causes which co-operate to produce these interesting differences.

The first diagram presents the hourly variations of the temperature at Fort Kearney, Nebr., in June. The mean temperature was 77°.5, Fahrenheit, while at Philadelphia it is only 68° to 69° in June, although the latter place is situated over two-thirds of a degree of latitude farther south, and over 2,000 feet lower. We have no reason to believe that the temperature of June, 1858, at Fort Kearney, has been so much above the average that this result should not indicate a considerable northward bend in the lines of equal temperature for that season in the plains of the Platte River region. It merely confirms prior observations, and verifies the result of theoretical deductions, based upon the situation of that country, in the center of a large continent, far away from any sea-coast, and open toward the north and south. It should be borne in mind that the values for Philadelphia are deduced from a much larger series of observations than those at Kearney, which latter might perhaps be a little above the actual average. Still, these and all the other observations have not been taken on days especially selected for the purpose, but indiscriminately, as the execution of the surveys made it convenient. For that reason they might as well present smaller values than the average. The difference between the warmest and coldest hours of the day at Fort Kearney amounts to 21° Fahrenheit, while at Philadelphia, according to table F, the amplitude is only 15°.4. This, too, is a consequence of the continental situation of the place. The actual amount of vapor in the atmosphere at Kearney was larger than at Philadelphia, on account of its higher temperature, but the relative humidity, the degree of saturation of the air, was less at Kearney. For the same reason, the cloudiness was much less at Kearney, only 3.35, against 6.6 at Philadelphia. (See table G.) Therefore, although a little more heat was absorbed or made latent by the evaporation at Kearney, it was comparatively less than at Philadelphia. The greater clearness of the sky offered less obstruction to the rays of the sun and to their heating influence upon the earth's surface during the day, and to the cooling by radiation during the night. Thus the mean temperature and the amplitude were both increased. The increase of the temperature during the hours of the morning was gradual at Fort Kearney, because the quantity of moisture which was evaporated during that time, and therefore of heat made latent, was considerable. It reached an amount which would justly astonish those not used to such contemplation. From our Table E we see that the minimum amount of vapor in 1 cubic foot of air was 6.38 grains at 5 a. m.; the maximum, 7.41 grains at 10 a. m. In order to supply the difference of 1.03 grains, or, rather, taking the expansion into consideration which has taken place during those hours, of 1.04 grains to a stratum of air of 1 foot thick over 1 square mile, over 5,000 pounds troy of water must be evaporated, and for a stratum of 500 feet, over 2,500,000 pounds are required. If we consider that the evaporation continues with increased intensity after 10 a. m., and that the vapor diffuses itself, although in decreasing quantity, into the higher portions of the atmosphere, we can form an adequate estimation of the heat absorbed in that process, and understand the cause of the slowness of the increase of heat during the morning. The decrease of temperature is quickest toward sunset, because then the source of the heat disappears, but during the night it is not as considerable as we might expect it to be. Although the radiation is great, its effects are balanced, in a measure, it appears, by a partial precipitation of the moisture evaporated during the day, by which a large amount of the heat made latent during the day is again rendered sensible. Besides, the currents of air, which during the day carry the heated air on high, have subsided in the evening. Thus a more rapid cooling of the earth's surface during the night is prevented. The maximum of the temperature was reached at an earlier hour at Kearney than at Philadelphia, namely, at 2½ p. m. instead of 3½ p. m., perhaps, also, on account of the greater lightness and clearness of the atmosphere, but especially on account of the greater intensity of evaporation at Kearney, which caused a more rapid depression of the temperature after the source of the heat had passed the point of greatest intensity; in other words, after the sun had passed the meridian.

The diagram No. VI of the mean daily oscillations of the temperature at Camp Floyd during the first third of November has a very marked shape. The temperature rose rapidly in the morning, because the sky was clear and the humidity exceedingly small, so that only little heat was absorbed by evaporation. As soon as the maximum had been passed, at 2 p. m., it began declining rapidly, and continued thus until about an hour and a half after sunset. By this time the earth's surface had lost the greatest portion of its surplus heat by radiation, and nearly reached the point of mean temperature of the season. The upward currents of air had also probably died out. From this time to sunrise of next morning the temperature appeared to decline uniformly, but at a much lower rate. The amplitude amounted to 28° Fahrenheit, while the greatest mean amplitude of any month at Philadelphia scarcely reaches 16°, and that of November is considerably less.

Still larger amplitudes were obtained from the observations at the end of May, in Woodruff Valley, and in September, at Camp Floyd. The former are represented by the diagram VIII. They both give the most striking illustration of an extremely continental climate. In Woodruff Valley the mean temperature was then 55° Fahrenheit against 56° at Philadelphia, and the mean amplitude 45° Fahrenheit against 15°.4 at Philadelphia. At the time of the observations at Camp Floyd, in September, the mean temperature was 64°.7, while the mean temperature of the month, according to the above tables, is 58°.4 against 57° at Philadelphia, and the amplitude amounted to 48°.3 Fahrenheit against 13°.7 at Philadelphia. The latitude of the former is 45′ south, that of the latter 16′ north of that city, while their elevation above it is about 6,000 and 4,800 feet respectively. Taking into consideration the decrease of temperature due to such considerable elevations, which may be put down as about 18° and 14° Fahrenheit, the great northward deflection of the lines of equal temperature, is again apparent. The following remarks especially apply to the variations in September. The temperature increased at once rapidly after sunrise, because the extremely small amount of humidity on the ground absorbed little heat by evaporation; and it continued increasing nearly at the same ratio until afternoon. The dry and sparsely-covered soil of the plains became intensely heated. The temperature reached its maximum about 2 p. m., an hour earlier than it is reached at Philadelphia, chiefly it appears on account of the greater clearness of the atmosphere, the stronger ascending currents of air, and the greater difference of heat between the heated surface of the desert plains, and the upper regions of the air and the towering summits of the adjoining mountain ranges. The decrease of temperature then began soon after the maximum had been reached; it was strongest between 5 and 7 p. m., about the time of sunset, but continued with considerable force throughout the night. At 7 p. m. the thermometer read already 26° below the maximum, and had attained the mean temperature of the day. Some of the causes which co-operated to produce these results are the following: The radiation was very intense, the more so because the atmosphere was beautifully clear, and the cloudiness of the sky amounted only to 0.7 against 5.5 at Philadelphia as the mean for September. The bare parched soil, on the other hand, gave off its heat comparatively slowly, like a heated brick, and thus prevented the temperature from sinking still more rapidly, as we might expect from a comparison with some of the other diagrams; and it thus cooled gradually until it was heated again by the rising sun. Another cause for the continued strong decrease of temperature during the night was the continued evaporation, which was not interrupted during the night. On account of the scarcity of moisture, its effects were not so intense as they would have been otherwise. If the soil would have been less dry the temperature would have decreased more rapidly toward sunset, but much less during the latter part of the night, when, on the contrary, precipitation would again have taken place, and latent heat thus have become sensible. As it was, only so much could evaporate as rose gradually to the surface from the badly-supplied substrata, and while the refrigerating effects of the evaporation were not intense at any hour, they were continually felt throughout the whole of them.

The temperature curve of Genoa for June shows a remarkable feature. The maximum of temperature took place there at 1.30 p. m., while at Philadelphia it recurs at 4 p. m. I do not suppose that this could have been produced by the same influences which cause the early maximum at San Francisco, although they are scarcely 160 miles apart, but I consider the peculiar situation of our camp the main cause. It was pitched on the rocky slope at the very foot of the main range of the Sierra Nevada, facing a little south of east. During the forenoon the sun burned intensely on this slope and on the sides of the mountains, but early in the afternoon its rays fell obliquely upon the ground, and it soon disappeared altogether behind the mountains. Thus an early maximum was caused, and a rapid decrease of the temperature between 5 and 6 p. m., corresponding to one or the other diagrams at the hour of sunset, which then took place only between 7 and 8 p. m.

The variations of the relative humidity are not less interesting than those of the temperature. Turning at once to the diagrams I will point out some of their most remarkable features, and compare them with the results obtained at Philadelphia, contained in Table F. The most characteristic one is again No. VIII for Woodruff Valley, in the last days of May. It illustrates the extremely arid climate of the interior of Utah. The maximum of saturation at the time of sunrise, at 4.30 a. m., was 74, saturation being 100. If the soil was covered with grass instead of being nearly bare, dew, or rather frost, might then have been formed, under else favorable circumstances, by a very slightly farther decrease of temperature. This, however, was only due to the great depression of the temperature during the night to below the freezing point, not to a large quantity of vapor in the atmosphere, which actually amounted to only 1.5 grains in a cubic foot of air. With the rapid increase of temperature, the degree of saturation decreased so much that at 9 a. m. it was only 22, because the ground was extremely dry, and the little vapor which was formed was carried on high by the ascending currents of air.

While the maximum of the temperature took place at 3 p. m. the humidity, therefore, continued to decrease; at 6 p. m. it was 5.3, and the minimum seemed to take place at about 20 minutes past 6, an hour before sunset, with 4.5. From that time to sunrise of next morning the relative humidity increased nearly uniformly. The amplitude was 69.5 and the mean degree of saturation 29.1. At the same season at Philadelphia, with nearly the same mean temperature, the maximum of saturation at sunrise is about 91, the minimum, between 3 and 4 p. m., about 64, the amplitude, therefore, only 27, and the mean 78.9. A glance at these numbers is sufficient to convince anybody that agriculture can never be carried on there except by irrigation, and they prove, at the same time, that water for that purpose must be exceedingly scarce, so that only a few acres might be cultivated out of stretches of many miles in extent. The plants, however, withstand such extreme changes much better than it might be expected, because the very dryness of the atmosphere protects them from being injured by the night frosts.

At Camp Floyd, in the middle of September, as represented in diagram No. VI, the mean humidity was still less, viz, 21.9; but the amplitude was not as large, only 39; the maximum, at 5.30 a. m., being 42.5, and the minimum, at 3.30 p. m., being 3.5. The corresponding numbers for Philadelphia are 82.5 as mean, 94 as maximum, 67 as minimum at 3 p. m., and 27 as amplitude. We have seen that the amplitude of temperature was even larger at Camp Floyd in September, than at Woodruff Valley in May, and the question arises, why the amplitude of humidity was so much smaller at the former place. The main difference in both diagrams is the smaller increase of humidity between sunset and sunrise. At Woodruff Valley it increased proportionally to the decreasing temperature, perhaps, because the vapor carried off by rising currents of air was replaced by evaporation from a little creek near our camp, or because, perhaps, the prevailing wind brought on as much vapor as was carried off.

At Camp Floyd, on the contrary, the increase of humidity did not keep pace with the decrease of the temperature. Either more vapor was carried off by rising currents than was replaced by the cold air replacing them, or dry wind must have prevailed during the nights.

In August, at Camp Floyd, the saturation was more complete than in September, being 38, and in April it was still higher, equal to 57, with an amplitude of 54.5 and

44.0, respectively; while at Philadelphia it was smaller in April, viz, 76.1; and in August equal to September, viz, 82.5, with amplitudes of 26 and 25, respectively.

In the diagram No. VII for Genoa, Carson Valley, we can again clearly recognize the influences which have affected the variations of the temperature. The minimum of only 11.4 was reached as early as 1 p. m. Then, even before the temperature had decreased, the evaporation from the adjoining widely overflowed meadows of the valley of Carson River appeared to increase the humidity of the air at our camp, perhaps carried there by regular currents of air. To the rapid falling of the thermometer between 5 and 7 p. m. corresponds the irregular increase of the humidity, marked by a dotted line on the diagram. As it appeared irregular, and is evidently due to the peculiar situation of the place, I have eliminated it from Table E, but it can readily be accounted for as being peculiar to the locality. During the hours of the night the humidity increased considerably, in accordance with the decrease of the temperature. The small mean relative humidity of only 30.6 is remarkable, because the loftiest summits of the Sierra in the neighborhood were still covered with snow, the whole lower portion of Carson Valley, many miles in extent, had for weeks been overflowed, and the extensive sheet of water of Lake Bigler commences not more than 2 or 3 miles from Genoa. It indicates that Carson Valley decidedly belongs to the climatical system of the vast deserts of Carson Lake, of the sink of Humboldt River, &c., and that its peculiar climatical features are chiefly derived from them.

The curve No. I of Fort Kearney, also, for June, is much more similar to that of Philadelphia. The maximum is 89.5, the minimum 68.4, while at Philadelphia the maximum is 93, the minimum 64, at 3 and 4 p. m., the amplitude therefore 29, while the mean is 78.9. We thus find, again, that the neighborhood of Fort Kearney, although arid compared with that of the eastern coast, and much less adapted to agricultural pursuits, is still moist compared with that of the desert valleys of Utah.

The diagram No. III, obtained at Fort Bridger in the first days of September, is also very remarkable. The maximum, just before sunrise, about 3 a. m., was 40. The saturation then declined rapidly with the increasing temperature, and was nearly stationary between 9 a. m. and 2 p. m., about 10; then it began to increase uniformly till sunrise of next morning. The mean degree of saturation was only 21.6, the amplitude 30.5. These features can again be explained by the situation of the place and the weather at the time. Fort Bridger is situated in a low meadow, well watered by several branches of a creek. Strong western winds prevailed at the time, which, coming from the arid regions of the Great Basin, were extremely dry. Under their influence the saturation decreased very rapidly with the increase of the temperature. By 9 o'clock, however, the temperature had become sufficiently high to produce a powerful evaporation on the moist surface which balanced the desiccating influence of the wind. With the declining temperature, after 3 p. m., the evaporation becomes also less, and the dry western winds exercised a greater influence upon the saturation of the air than the declining temperature. The relative humidity could, therefore, only increase very gradually and slowly during the night.

I may remark that the difference between the mean values of the relative humidity obtained from the computation of the single observations, in several instances, differs considerably from those computed from the mean of temperature and mean force of vapor of the same observation, the more so the larger the amplitudes of arc. As those obtained in the first-stated manner are, however, more correct, I have given them in the column of means. Apparent errors may thus be explained. The same may be said in regard to the computation of the weight of vapor.

The hourly changes of the quantity of vapor in the atmosphere, represented by the weight of vapor in one cubic foot of air in the lower portion of the atmosphere, has not been illustrated by diagrams, because the values given in the above table were not obtained by direct computation of each observation, but by an indirect computation from the mean values of temperature and relative humidity. If not absolutely correct on that account, still they come very near being so. In the general remarks at the head of this chapter, I have stated that in Western Europe generally the minimum quantity of vapor in the air is to be found about sunrise, that it attains its greatest maximum about 9 a. m., then decreases till toward 4 p. m., and attains a second smaller maximum toward 9 p. m., when it decreases until sunrise; that in winter, however, when the action of the sun is less intense, there is generally only one minimum, about sunrise, and one maximum, about 2 p. m. From our Table F we see that at Philadelphia, probably on account of its situation near the coast, the changes are not so uniform. In January there is a minimum between 7 and 8 a. m., and a maximum between 3 and 7 p. m., with the highest point probably at 6 p. m. The average amount of vapor in 1 cubic foot of air is 2.01 grains, and the amplitude only 0.24 grains. In April there is a minimum about the time of sunrise, from 4 to 6 a. m., a maximum from 11 a. m. to 6 p. m., after which the quantity of vapor decreases until 10 p. m., when it continues nearly unchanged to the time of the lowest minimum. The average amount is 3.43 grains; the difference between the largest and smallest weight, 0.45 grains. In June a minimum takes place at 5 a. m.; the quantity is largest, with little oscillation, from 9 a. m. till 7 p. m., with the highest point at 6 p. m., and then it decreases till morning. The mean quantity is 5.97; the amplitude 0.65 grains. In August 5 a. m. is the time of the minimum; from 11 a. m. to 6 p. m. the quantity of vapor is largest, with the highest maximum at 6 p. m., after which time it decreases till morning. The mean is 6.86 grains; the amplitude 0.83 grains. In September the minimum falls in the hour of sunrise, as in the other months, namely, between 5 and 6 a. m.. The quantity then increases rapidly till 9 a. m.; then very slowly. The maximum takes place from 4 to 6 p. m. The mean quantity amounts to 5.63 grains; the amplitude to 0.55 grains.

The variation at Philadelphia, at least in the above-named months, which alone I have examined, show, therefore, all one decided minimum about and soon after sunrise, and one maximum, of long duration, generally between the hours of 9 a. m. and 7 p. m., which has its highest, but not sharply-marked point, about 6 p. m. Instead of a second maximum at 9 p. m., we find about that hour rather indications of a second minimum.

Our values in Table E, from the central portion of the continent, are altogether different; they prove more than anything else the absolute difference of climate there, and its extremely arid and continental character. In Woodruff Valley, at the end of May, and in Camp Floyd, in August and September, we have the strongly-marked minimum between 4 and 7 p. m., and the equally-marked maximum between 8 and 9 a. m., nearly the reverse of what we have found for Philadelphia. At the same time the average amount of humidity has been very small, and the difference between the maximum and minimum of the day has been from two to three times as large as at Philadelphia. All the features are more distinctly marked than in less extreme climates.

In Woodruff Valley, at the end of May, the sun rises about 4.30 o'clock. The first effect of the rapid increase of the temperature was expansion of the air and vapor, and consequently a slight depression of the weight of vapor in each cubic foot of the expanded air. This depression, although scarcely perceptible, corresponds to the sunrise minimum at Philadelphia, or, rather, it depended upon the same agencies which cause the extension of that minimum beyond the hour of sunrise. It was prolonged somewhat by the upward movement of the warmed air and the vapor contained in it, which began soon after sunrise, and by the circumstance that the little humidity which had accumulated during the night in the soil was rapidly decreasing. Still the evaporation soon became so vigorous that it gained upon the other agencies, and at 8 a. m. the maximum was reached, which, however, was not much above the point which the quantity of vapor had attained at sunrise, just before the depression had taken place. Then, however, most of the available moisture had been consumed, as may be seen from the corresponding diagram of the relative humidity; and, therefore, the increasing expansion of the air and the rising currents gained upon the evaporation, and the quantity of vapor in each cubic foot of air in the lower stratum of the atmosphere was diminished gradually until 7 p. m., when it had reached the exceedingly low amount of 0.35 grains, while the air would have required at that time over 7 grains for its saturation with vapor. This was shortly before sunset, at the time when under ordinary circumstances there ought to have been a maximum. The temperature now sank more and more, while a limited evaporation continued, and both causes combined effected a gradual increase of the quantity of vapor, which continued until sunrise. The average amount in one cubic foot was only 1.08 grains, and the difference between the largest and smallest amount 1.26 grains troy.

At Camp Floyd, in September, the maximum took place at 9 a. m., the minimum, chiefly on account of the earlier setting of the sun, already at 4 p. m., with only 0.45 grains of vapor in a cubic foot of air. The increase lasted then to midnight, when no further change took place until after sunrise at 6 a. m., when the increase commenced again and lasted until the maximum was reached. The stability during the night, notwithstanding the continued decrease of the temperature, must be attributed to the same agencies which have affected the relative humidity, and which I have already mentioned in that connection, namely, rising currents of air on a dry wind from the neighboring deserts. Winds exercise the greatest influence upon the evaporation and conditions of moisture. In general, a wind increases the evaporation considerably, the more so when it happens to be warm and dry. If it is warm and charged with moisture, it either increases the evaporation little or not at all, and if the station is much colder, the moisture of the wind may even be precipitated. A cold wind does not increase the evaporation so much, especially if it is itself charged with moisture, and it can only create precipitation by cooling the air at the station below the point of saturation before it has carried off the surplus moisture of the air from that point; therefore the common saying that a wind is too cold to bring on rain. The average amount of vapor in 1 cubic foot of air at Camp Floyd, in September, was 1.16 grains, and the amplitude 1.44 grains.

At Camp Floyd, in August, the conditions were similar. The maximum took place from 8 to 9 a. m.; then followed a gradual decrease till 6 a. m., when the humidity increased again steadily, as in Woodruff Valley, to the time of the maximum at 9 a. m. Only a slight check was felt at the time of sunrise, but no perceptible depression. The average quantity was 2.59 grains, the amplitude 1.72 grains—more than I have observed at any other point.

At Camp Floyd, in April, the whole conditions were different, as I have stated before, in connection with Table C; and, therefore, the variations were also entirely different. There was a sunrise minimum at 5 a. m., a maximum at 10 a. m., a minimum at 7 p. m., as low as the first one, and a second but lower maximum at 11 p. m. These variations are unlike those at Philadelphia, but similar to those observed in Western Europe. The average amount of vapor was 1.68 grains, the amplitude only 0.49 grains.

The oscillations at Fort Kearney in June were somewhat similar, but the average amount of moisture there was 6.75 grains, much more than I have observed in any month in Utah, and even more than at Philadelphia in June, with, however, a lower mean temperature, and, consequently, more complete saturation at the latter place. The amplitude amounted to 1.10, while at Philadelphia only to 0.65 grains.

The oscillations at Fort Laramie in the first days of August were not so characteristic, but more influenced by contending agencies. Those at Genoa in June are, of course, more similar to the other from Utah, but they exhibit some peculiarities. The maximum took place at 9 a. m., but the minimum as early as 1 p. m., when the same causes mentioned in connection with the relative humidity and the declining temperature caused an increase of the quantity of vapor, which culminated at 4 p. m. The rapid decrease of temperature caused a second minimum at 8 p. m., not quite as low as the first one. The upward currents of air had then subsided, while the evaporation continued in the damp valley. The humidity, therefore, increased again, suffered a slight check shortly after sunrise, the same as at Woodruff Valley, when, as there, it soon continued increasing to the maximum. The mean amount was 2.67 grains, the difference between the largest and smallest quantity 1.62 grains.

The hourly variations of the force of vapor and its absolute quantity are not less abnormal in the region covered by our explorations; but, as they depend upon the weight of vapor and the degree of temperature, and indirectly upon the relative humidity, and are determined by their relative quantity and changes, I may be shorter in my remarks.

Table F shows that at Philadelphia one minimum and one maximum takes place every day, the former about the time of sunrise, when the temperature is lowest and the quantity of vapor smallest, the latter in the afternoon, when the temperature is highest and the quantity of vapor largest, while the relative humidity is not too low. In January the minimum takes place between 6 and 8 a. m., and the maximum lasts, with little changes, from 2 to 7 p. m. The mean force is then 0.170 inches, and the amplitude 0.022 inches. In April, the minimum takes place between 4 and 6 a. m., the maximum lasts from 1 to 3 p. m.; then, however, the decrease is only very slow for several hours. At 11 p. m. there is a slight indication of a second minimum. The mean force is 0.300 inches, the amplitude 0.048 inches.

In June, the minimum takes place from 4 to 5 a. m., the maximum at 2 p. m., but the pressure is high from before noon till 7 p. m. The mean force is 0.540 inches, the amplitude 0.074 inches.

In August, the minimum takes place at 5 a. m., the maximum lasts from 2 to 6 p. m., or we might even say from 11 to 6; the mean force is 0.625 inches, and the amplitude 0.084 inches.

In September the minimum lasts from 4 to 6 a. m., the maximum from 5 to 6 p. m., but the pressure is high from 11 a. m. to 6 p. m. The mean force is 0.507 inches, and the amplitude 0.063.

The means of a single month, however, do not show such uniform results. A glance at the diagrams illustrating the observations at the Girard College, Philadelphia, as published by order of Congress, shows that the pressure varies much in the same month of different years. We frequently find two maxima and two minima as well in winter as in summer.

The most abnormal of our diagrams is again that for Woodruff Valley at the end of May, No. VIII. It exhibits exactly the reverse of the Philadelphia variations. The maximum then took place at sunrise, and the minimum in the afternoon. The cause of this peculiarity will be readily understood. At sunrise the quantity of vapor was not much below its maximum, and the relative humidity so decidedly at its maximum that the great depression of the temperature could not counteract those combined influences. The relative humidity then declined so rapidly that its influence gained upon that of the increasing temperature, and the force of the vapor gradually declined. By noon the temperature had nearly reached its maximum, and therefore the still decreasing quantity of vapor and relative humidity caused a rapid diminution of the pressure, which lasted till near sunset, when it had attained the exceedingly low figures of 0.038 inches. The rapidly increasing relative humidity then raised it, notwithstanding the continued decrease of the temperature, till it reached the maximum at sunrise. The mean force was 0.093, only the fifth part of what it is at that season at Philadelphia, and the amplitude reached the large figure of 0.091 inches.

At Camp Floyd in September, as illustrated by diagram No. VI, the decrease of the relative humidity was slower in the morning; therefore the influence of the temperature gained upon it, and a divided maximum took place at 9 a. m., upon which the decrease of the force became very rapid until it reached its minimum, about 4 p. m.; then, with the increasing relative humidity, it increased first faster then less till near midnight, when the influence of the decreasing temperature became as strong as that of the increasing relative humidity, and the force remained unchanged till sunrise. The mean force was very low, only 0.103 inch, the amplitude 1.29 inches.

The August curve at Camp Floyd is similar, but continues increasing, although less during the night. It shows, however, a bend after sunset in consequence of the very rapid sinking of the temperature at that hour. The mean force, although small, if compared to Philadelphia, was considerably larger, 0.238 inch, and the amplitude was larger than I have observed it anywhere else, 0.157 inch.

In April, at Camp Floyd, I found a sunrise minimum, as at Philadelphia, but a forenoon maximum and an afternoon minimum, as in August at Camp Floyd. The amplitude reached only 0.042 inch. Similar features are presented by the variations at Fort Kearney in June, but the amplitude there was larger, 0.088 inch, and the mean force much higher. In the Laramie curve the evening maximum, which had been small at Kearney, surpasses even the forenoon maximum. The Genoa curve is similar to the August curve of Camp Floyd; but on account of the peculiar local circumstances mentioned above, it has besides the maximum at 9 a. m., a second, although much lower, maximum in the afternoon about 4 p. m., and consequently also two minima, the lowest at 1 p. m., and a smaller one between 9 and 10 p. m.

The diagram for Fort Bridger, for the first days of September, No. III, is peculiar. As far as I can judge from the limited number of observations, there was a maximum at sunrise, for the same reason as in Woodruff Valley, then, on account of the rapidly diminishing relative humidity, a minimum at 9 a. m. By that time the humidity had become so low that it could not decrease much more, and the still increasing temperature created a maximum at 12 m.; at 3 p. m., the temperature and force of vapor were lower; at 6 the temperature had fallen considerably, but the relative humidity had increased comparatively more, and caused a third maximum, even a little higher than the two others, while later the force of vapor became again less, because the temperature became rapidly less.

In order to give a better comparison of the absolute values of the force of vapor, relative humidity, &c., I have arranged the following table, G. It contains the monthly means obtained at the Greenwich observatory, England, as the average of the seventeen years from 1841 to 1857; also the summary of the monthly means obtained at the observatory of the Girard College, Philadelphia, from 1840 to 1845, compiled from the records published by Professor Bache, by order of Congress; and besides the values obtained on our exploration, with the addition of a few means of temperature observed at Camp Floyd by Assistant Surgeons Williams and Moore, United States Army. Those data which have been deduced only from a short series of observations, and are repeated here from Table E, have been marked with letter. For particulars in regard to them I refer to the explanatory remarks to Tables C and D. Those marked *a*, are from the hourly observations in April at Camp Floyd; *b*, from the observations in August at Camp Floyd; *c*, from those in September at the same station; *d*, from Woodruff Valley in the last days of May and the first ones of June; *e*, from Genoa, Carson Valley, in June; *f*, from Fort Kearney, in June; and *g*, from Fort Laramie, in the last days of July and the first ones of August.

G.—*Comparative table of monthly means of temperature, force of vapor, relative humidity, &c.*

	Station.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean.
Mean temperature, degrees Fahrenheit.	Greenwich, England ..	38. 1	38. 5	41. 6	46. 5	52. 9	58. 7	61. 7	61. 4	56. 9	49. 5	43. 8	40. 5	49. 2
	Philadelphia, Pa	32. 3	32. 8	42. 3	50. 6	58. 9	68. 8	72. 8	71. 5	64. 1	51. 3	40. 7	32. 6	51. 6
	Camp Floyd, Utah.....	16. 2	29. 9	31. 9	43. 6	54. 7	74. 7	75. 0	72. 1	58. 4	50. 7	34. 0	22. 0	47. 0
					a 42. 0	*d* 55. 0	*e* 76. 3		*b* 69. 5	*c* 64. 7				
							f 77. 5		*g* 67. 0					
Force of vapor, inches, English, of mercury.	Greenwich, England ..	0. 205	0. 203	0. 216	0. 250	0. 300	0. 369	0. 417	0. 426	0. 383	0. 310	0. 260	0. 229	0. 297
	Philadelphia, Pa	0. 173	0. 173	0. 224	0. 293	0. 384	0. 545	0. 611	0. 622	0. 492	0. 312	0. 218	0. 173	0. 352
	Camp Floyd, Utah.....	0. 093	0. 147	0. 130	0. 154	*d* 0. 093	*e* 0. 248		*b* 0. 238	*c* 0. 103				* 0. 150
					a 0. 155		*f* 0. 628		*g* 0. 344					
Relative humidity, saturation = 100.	Greenwich, England ..	89.	86.	82.	79.	76.	74.	76.	78.	81.	86.	89.	88.	81.
	Philadelphia, Pa	85. 5	83. 7	78. 0	76. 6	75. 6	78. 0	76. 8	81. 6	82. 0	79. 6	80. 4	84. 8	80. 2
	Camp Floyd, Utah....	83. 5	84. 5	71. 3	51. 7	*d* 29. 1	*e* 30. 6		*b* 38. 0	*c* 21. 9				†54.
					a 57. 0		*f* 68. 4		*g* 57. 0					
Weight of vapor in 1 cubic foot of air, grains troy.	Greenwich, England ..	2. 4	2. 4	2. 5	2. 9	3. 4	4. 1	4. 6	4. 8	4. 2	2. 5	2. 9	2. 6	3. 4
	Philadelphia, Pa	2. 06	2. 06	2. 61	3. 35	4. 30	6. 02	6. 69	6. 83	5. 49	3. 56	2. 55	2. 06	3. 96
	Camp Floyd, Utah.....	1. 12	1. 74	1. 53	1. 77	*d* 1. 08	*e* 2. 67		*b* 2. 59	*c* 1. 16				
					a 1. 68		*f* 6. 75		*g* 3. 78					
Cloudiness of sky, the whole = 10.	Philadelphia, Pa	6. 8	6 0	7. 0	6. 7	6. 4	6. 6	5. 7	6. 3	5. 5	5. 3	6. 1	6. 5	6. 2
	Camp Floyd, Utah.....	4. 6	6. 2	5. 7	5. 1	*d* 1. 3	*e* 1. 3		*b* 0. 6	*c* 0. 7				
					a 5. 2		*f* 3. 4		*g* 4. 4					

* Estimated. † Estimated at.

This table does not require any further explanation. I will only state that the weight of vapor for January, February, March, and April, at Camp Floyd has been computed from the mean temperature, and the mean forces of vapor of these months, which I found to give, generally, more accurate results than if the mean relative humidity was directly introduced into the calculation. These means, for Camp Floyd, were deduced from three observations each day, at 7 a. m., 2 p. m., and 9 p. m. The means for these single hours were—

In January, force of vapor, 7 a. m., 0.062; 2 p. m., 0.137; 9 p. m., 0.079; relative humidity, 7 a. m., 92.0; 2 p. m., 72.0; 9 p. m., 86.4.

In February, force of vapor, 7 a. m., 0.117; 2 p. m., 0.189; 9 p. m., 0.135; relative humidity, 7 a. m., 89.3; 2 p. m., 76.6; 9 p. m., 87.6.

In March, force of vapor, 7 a. m., 0.114; 2 p. m., 0.160; 9 p. m., 0.118; relative humidity, 7 a. m., 78.3; 2 p. m., 61.4; 9 p. m., 74.3.

During these three months the mountains near Camp Floyd were heavily covered with snow, while in the valley the snow was a few inches deep in January, less in February, and disappeared in March. In April the snow disappeared from the lower mountains, but especially the eastern and northern slopes of the higher mountains, and the principal summits were still covered. In January from 9 to 10 inches of snow (not water) fell at Camp Floyd. In February it began 12 times to snow or rain, but the aggregate amount was very small; in March it snowed 10 times, once with a little rain, but the whole amount was again quite small; in April snow fell at 10 different times and rain at 3, but the whole amount of the precipitation did probably not reach half an inch of water.

EXTREMES OF TEMPERATURE, HUMIDITY, ETC.

After having, in the preceding paragraphs, treated of the values of the daily and monthly changes of temperature, moisture, and barometric pressure, which although extreme if compared with those of the same latitudes in the Eastern States, are the mean values and the rule in the localities where they have been observed, I will close these pages with the enumeration of some of the extreme changes and abnormal conditions recorded on this exploration. The following are actually recorded *differences of temperature between the warmest and coldest time of the day*, and they would, in many instances, be considerably larger, if the maximum and minimum temperatures had been observed. As we generally staid in a camp from afternoon till morning the amplitudes are mostly given between the high temperature of the afternoon and the low one of next morning, which are apt to give a little larger amplitude than the maximum and minimum of the same day would exhibit. We have observed as far east as Little Blue River, in Southeastern Nebraska, October 7th, 3 p. m., 75°; October 8th, 5.45 a. m., 34°; difference, 41° Fahrenheit.

Platte River, below Fort Laramie, September 20th, 3 p. m., 85°; September 21st, 5.15 a. m., 36°; difference, 49° Fahrenheit.

Near the Red Buttes, August 15th, 3.15 p. m., 82°; August 16th, 4.45 a. m., 37°; difference, 45° Fahrenheit.

Upper Sweetwater River, September 9th, 3 p. m., 70°.3; September 10th, 5.45 a. m., 26°.5; difference, 43°.8 Fahrenheit.

Green River, August 30th, 3 p. m., 83°; August 31st, 5.30 a. m., 39°; difference, 44° Fahrenheit.

Black Fork, September 1st, 4 p. m., 79°; September 2d, 5.30 a. m., 35°; difference, 44° Fahrenheit.

Bear River, September 26th, 3 p. m., 56°; September 27th, 6 a. m., 11°.5; difference, 44°.5 Fahrenheit.

Echo Cañon, September 10th, 6 a. m., 25°.5; 1.15 p. m., 75°; difference, 49°.5 Fahrenheit.

West of Weber River, September 11th, 4 p. m., 80°.5; September 12th, 5 a. m., 32°.5; difference, 48° Fahrenheit.

Timpanogos Cañon, September 20th, 3.30 p. m., 83°.5; September 21st, 6 a. m., 35°.5; difference, 48° Fahrenheit.

Camp Floyd, September 17th, 6 a. m., 40°; 12 m., 91°; difference, 51° Fahrenheit.

Camp Floyd, January 3d, 7 a. m., 0°.5; 2 p. m., 31°; difference, 31°.5 Fahrenheit.

Camp Floyd, January 18th, 7 a m., 5°.3; 2 p. m., 41°.7; difference, 36°.4 Fahrenheit.

Camp Floyd, April 8th, 6 a. m., 32°.7; 12 m., 71°; difference, 38°.3 Fahrenheit.

Camp Floyd, April 22d, 5.25 a. m., 20°; 3.15 p. m., 73°.3; difference, 53°.3 Fahrenheit.

Salt Lake Desert, August 1st, 4.30 p. m., 102°; August 2d, 4.30 a. m., 56°; difference, 46° Fahrenheit.

Reese River, May 28th, 3 p. m., 76°; May 29th, 4.50 a. m., 22°; difference, 54° Fahrenheit.

Over 40° difference was frequently observed in Woodruff Valley, the deserts near Carson Lake, and in other valleys of the Great Basin.

As the relative humidity was frequently small, the difference between the reading of the dry and wet bulb thermometers was frequently considerable. We must, however, bear in mind that this difference is no direct measure of the relative humidity. The following are some of the extreme values observed during the survey:

Fort Kearney, October 3d, 3 p. m., dry bulb, 87°.5; wet bulb, 58°.7; difference, 28°.8 Fahrenheit.

Independence Rock, (Sweetwater River,) August 16th, 3 p. m., 91° and 59°.3; difference, 31°.7 Fahrenheit.

Camp Floyd, September 17th, 3 p. m., 90° and 54°; difference, 36° Fahrenheit.

Prince's Creek, Utah, August 2d, 3 p. m., 87°.5 and 56°; difference, 31°.5 Fahrenheit.

In that vicinity, and about that time, the difference reached frequently 30°. At Genoa, Carson Valley, June 16th, 88°.5 and 56°; difference, 32°.5; and for several hours, 30 or 31°. At the same place, June 17th, 2 p. m., 92° and 58°.5; difference, 33°.5; and for several hours, 32°. On June 18th, 1 p. m., 94° and 59°; difference, 35°. June 19th, 12 m., 90° and 56°; difference, 34°; and June 20th, 3 p. m., 101°.5 and 66°; difference, 35°.5 Fahrenheit.

The force of vapor is subject to rapid changes by a change of the wind, and from other apparently small causes, independent of the regular daily variations. We find a change recorded on Big Sandy Creek, near Green River, August 27th, from 6.20 p. m. to 9 p. m., from 0.176 to 0.415; difference, 0.209 inch; and at Genoa, June 16th, from 12 m. to 1 p. m., from 0.204 to 0.088; difference, 0.116 inch in 1 hour, merely by a change of the wind, with a perfectly clear sky; and at the same place, on June 19th, from 11 a. m. to 12 m., from 0.252 to 0.067; difference, 0.185 inch in 1 hour. Some of the lowest values of force of vapor were deduced from observations at the following points: Copperas Springs, near Fort Bridger, September 27th, to 6 p. m., 0.000; Salt Lake Desert, May 8th, 9 p. m., 0.000; Pleasant Valley, Utah, May 9th, 3 p. m., 0.028; Antelope Valley, May 10th, 12 m., 0.027; Camp Floyd, April 21st, 5 p. m., 0.008; Camp Floyd, September 17th, 3 p. m., 0.014; Camp Floyd, January 12th, 7 a. m., 0.025, when the air was saturated with moisture on account of the low temperature; also, January 11th, 7 a. m., 0.026; January 10th, 9 p. m., 0.026; Fort Bridger, September 4th, 3.30 p. m., 0.027; Fort Bridger, September 29th, 10 a. m., 0.022; Woodruff Valley, May 31st, 6 p. m., 0.015.

Extremely small values of saturation, or *relative humidity*, are the following: Copperas Springs, near Fort Bridger, September 27th, 6 p. m., 0; Salt Lake Desert, May 8th, 9 p. m., 0; and at neighboring points, on successive days, 4 and 7; Fort Bridger, September 4th, 3.30 p. m., 3; Fort Bridger, September 29th, 10 a. m., 3; Camp Floyd, April 21st, 5 p. m., 2; April 23d, 6 p. m. and 8 p. m., 11; Camp Floyd, August 8th, 4 p. m., 9; Prince's Creek, August 2d, 3 p. m. and 6 p. m., 8; Woodruff Valley, May 30th and 31st, 6 p. m., 3; June 1st, 3 p. m., 3; Alkali Wells, June 4th, 6 p. m., 7; Walker River, June 8th, 3 p. m., 7; Genoa, June 19th, 12 m., 5; Little Sandy Creek, near South Pass, August 26th, 3 p. m., 8; and as far east as Fort Kearney, October 3d, 3 p. m., 10.5.

It was astonishing to see how little influence, sometimes, rain had on the humidity of the atmosphere, because it was found in the upper regions while the lower atmosphere was dry, and it did not extend far. At Plympton Springs, in the Salt Lake Desert, July 23d, between 3 and 4 p. m., 0.30 inch of rain fell, during a thunder-storm, with hail; our camp was flooded, and after 6 some more rain fell. Still the relative humidity, which at 3 p. m. was 38, at 6 p. m. had only increased to 50. Again, in White Valley, on July 25th, a thunder-storm, with, however, only little rain, was recorded as lasting from 4 to 6 p. m.; the relative humidity at 4 p. m. was 25; at 6 p. m., 28.

APPENDIX F.

TABLE OF DISTANCES,

ALTITUDES, AND GRADES.

APPENDIX F.

TABLE OF DISTANCES, ALTITUDES, AND GRADES.

Names of places.	Intermediate distances, in miles.	Total distances, in miles.	Altitudes, in feet, above the sea.	Difference of altitudes, in feet.	Grade, in feet, per mile.
Fort Bridger	0	0	6, 656	0	0
Summit between Fort Bridger and Muddy Creek	10. 7	10. 7	7, 653	997	93. 1
Muddy Creek	2. 5	13. 2	6, 992	661	264
Summit between Muddy Creek and Sulphur Creek	7. 2	20. 4	8, 060	1, 068	148
Sulphur Creek	5. 0	25. 4	7, 450	610	122
Bear River	11. 1	36. 5	7, 395	55	5
Summit between Bear River and White Clay Creek	5. 0	41. 5	7, 736	341	68
Camp, 17 miles from the mouth of White Clay Creek	12. 1	53. 6	6, 471	1, 265	104
Mouth of White Clay Creek	17. 0	70. 6	5, 526	945	55
Camp on Weber, 2.6 miles from junction of White Clay Creek	2. 6	73. 2	5, 572	46	17
Ford	1. 5	74. 7	5, 686	114	76
Summit on Parley's Park road, between Weber River and Silver Creek	12. 2	86. 9	6, 891	1, 205	98
Silver Creek	1. 2	88. 1	6, 422	469	390
Summit between Silver Creek and Round Prairie	5. 5	93. 6	6, 715	293	53
Round Prairie	9. 2	102. 8	5, 571	1, 144	124
Near Warm Springs	1. 7	104. 5	5, 556	15	8
Camp on Timpanogos, 12.5 miles above bridge	7. 5	112. 0	5, 246	310	41
Bridge over Timpanogos	12. 0	124. 0	4, 860	386	32
Low ground southeast of and near Lehi	11. 5	135. 5	4, 546	314	27
Bridge over the Jordan River	5. 4	140. 9	4, 540	6	1
Camp Floyd	14. 1	155. 0	4, 860	320	22
Camp Floyd Pass	4. 5	159. 5	5, 234	374	87
Camp No. 1, Meadow Creek	13. 7	173. 2	5, 205	29	2
General Johnston's Pass, Guyot range (summit)	9. 1	182. 3	6, 237	1, 032	113
Camp No. 2, western slope of Guyot range	. 8	183. 1	5, 816	421	526
In Skull Valley	9. 3	192. 4	4, 850	966	103
Camp No. 3, Simpson's Spring, base of Mount Champlin	7. 0	199. 4	4, 850	0	0
In Salt Lake Desert	9. 5	208. 9	4, 370	480	54
Short-Cut Pass (summit)	12. 2	221. 1	5, 347	977	80
Camp No. 4, western slope, Thomas's range	1. 8	222. 9	5, 005	342	190
Foot of slope	12. 6	235 5	4, 298	707	56
Camp No. 5, Fish Spring, Salt Lake Desert	12. 9	248. 4	4, 289	9	0. 6
Camp No. 6, in Salt Lake Desert	29. 7	278. 1	4, 593	304	10. 2
Camp No. 7, Sulphur Spring	2. 6	280. 7	4, 633	40	15
East summit of Tots-arr range	10. 0	290. 7	6, 903	2, 270	227
Camp No. 8, Pleasant Valley	3. 4	294. 1	6, 150	753	221
West summit of Tots-arr range	8. 5	302. 6	7, 150	1, 000	117
Western foot of slope	1. 4	304. 0	6, 675	475	339
Ridge east of Antelope Valley	1. 4	305. 4	6. 995	320	228
Camp No. 9	1. 2	306. 6	6, 658	337	280
In Antelope Valley	5. 3	311. 9	5, 690	968	182
Ridge between Antelope Valley and Spring Valley	10. 7	322. 6	6, 560	870	81
Camp No. 10, Spring Valley	3. 0	325. 6	6, 133	427	142
Un-go-we-ah Mountains (summit)	9. 0	334. 6	7, 530	1, 397	155
Camp No. 11, west slope of Un-go-we-ah Mountains	2. 1	336. 7	6, 600	930	443
In Steptoe Valley	6. 5	343. 2	5, 816	784	120
Camp No. 12, mouth of Egan Cañon	6. 8	350. 0	5, 986	170	25
Mon-tim range (summit)	5. 2	355. 2	7, 135	1, 149	220
Do	3. 1	358. 3	7, 135	0	0
Foot of Mon-tim range in Butte Valley	2. 9	361. 2	6, 148	987	340
Camp No. 13, Butte Valley	6. 8	368. 0	6, 523	375	53
Ridge between Butte Valley and Long Valley	1. 8	369. 8	6, 670	147	81
In Long Valley	4. 7	374. 5	6, 195	475	101
Camp No. 14, near summit of Too-muntz Mountains	5. 5	380. 0	7, 190	995	180
Too-muntz range (summit)	0. 7	380. 7	7, 283	93	132
In Ruby Valley	4. 9	385. 6	6, 034	1, 249	255
Camp No. 15, Ruby Valley	3. 6	389. 2	5, 953	81	22
Hastings's Pass (summit)	5. 7	394. 9	6, 580	627	110
In Valley of South Fork of Humboldt	8. 6	403. 5	5, 640	940	109
Camp No. 16, eastern base of We-ah-bah Mountains	3. 3	406. 8	6, 028	388	118
Summit of We-ah-bah range	4. 0	410. 8	7, 300	1, 272	318
Camp No. 17, Pah-hun-nu-pe Valley, west foot of We-ah-bah Mountains	3. 1	413. 9	6, 018	1, 282	413
In Pah-hun-nu-pe Valley	4. 0	417. 9	5, 660	358	90
Camp No. 18, Pah-hun-nu-pe Valley	9. 3	427. 2	5, 692	32	3
Cooper Range (summit)	8. 7	435. 9	6, 757	1, 065	122
Camp No. 19, Ko-bah Valley, She-u-wi-te Creek	6. 2	442. 1	6, 414	343	55

APPENDIX F.—*Table of distances, altitudes, and grades*—Continued.

Names of places.	Intermediate distances, in miles.	Total distances, in miles.	Altitudes, in feet, above the sea.	Difference of altitudes, in feet.	Grade, in feet, per mile.
Camp No. 20, Ko-bah Valley	17. 5	459. 6	5, 993	421	24
Ridge in Ko-bah Valley	3. 5	463. 1	6, 690	697	199
Camp No. 21, Wons-in-dam-me Creek	3. 5	466. 6	6, 595	95	27
In Ko-bah Valley	3. 8	470. 4	6, 210	385	101
Camp No. 22, east of Pah-rea range	9. 9	480. 3	6, 373	163	16
Pah-rea range (summit)	4. 0	484. 3	6, 440	67	17
In Won-a-ho-no-pe Valley	7. 5	491. 8	5, 443	997	133
Camp No. 23, eastern slope of Pe-er-re-ah Mountains	5. 5	497. 3	5, 870	427	77. 5
Camp No. 24, eastern slope of Pe-er-re-ah Mountains	4. 9	502. 2	6, 355	485	99
Pe-er-re-ah Mountains (summit)	4. 7	506. 9	7, 104	749	159
In Reese River Valley	6. 5	513. 4	5, 530	1, 574	242
Camp No. 25, on Reese River	2. 6	516. 0	5, 563	33	13
Ridge between Reese River Valley and Woodruff Valley	13. 3	529. 3	6, 483	920	69
In Woodruff Valley	2. 1	531. 4	6, 000	483	230
Camp No. 26, Smith Creek, in Woodruff Valley	5. 8	537. 2	5, 960	40	6
Camp No. 27, Putnam Creek	10. 0	547. 2	6, 325	365	36. 5
Se-day-e or Lookout Mountains (summit)	5. 0	552. 2	7, 741	1, 416	283
Camp No. 28, Gibralter Creek, west slope of Se-day-e Mountains	3. 7	555. 9	6, 360	1, 381	373
Camp No. 29, Middle Gate	14. 7	570. 6	4, 665	1, 695	115
Ridge east of Dry Flat Valley	8. 8	579. 4	4, 460	205	23
In Dry Flat Valley	10. 2	589. 6	4, 090	370	36
Ridge between Dry Flat Valley and Alkali Valley	1. 2	590. 8	4, 500	410	341
In Alkali Valley	1. 7	592. 5	3, 960	540	317
Camp No. 30, Alkali Valley	2. 6	595. 1	3, 900	60	23
Camp No. 31, on Carson Lake	16. 0	611. 1	3, 840	60	3. 7
Ridge between Carson Lake and Walker's River	24. 2	635. 3	4, 595	755	31
Camp No. 32, on Walker's River	7. 0	642. 3	4, 072	523	74. 7
Camp No. 33, on Walker's River	10. 0	652. 3	4, 200	128	12. 8
Camp No. 34, on Walker's River	6. 0	658. 3	4, 288	88	14. 6
Divide between Carson River and Walker River	6. 7	665. 0	4, 700	412	61. 5
Ridge above Camp No. 35	9. 3	674. 3	4, 400	300	32
Camp No. 35, on Carson River	3. 0	677. 3	4, 200	200	67
Camp No. 36, Pleasant Grove, on Carson River	9. 0	686. 3	4, 288	88	10
Chinatown	7. 5	693. 8	4, 360	72	9
Camp No. 37, Carson City, Eagle Valley	11. 5	705. 3	4, 587	227	19
Genoa	13. 5	718. 8	4, 824	237	17
Daggett's Pass, off the route, about 3 miles from Genoa	3. 0	....	7, 180	2, 356	.....
Bridge over west branch of Carson River	16. 8	735. 6	5, 698	874	52
Hope Valley	5. 2	740. 8	6, 880	1, 182	227
Luther's Pass (summit)	2 2	743. 0	7, 505	625	284
In Lake Valley	4. 6	747. 6	6, 260	1, 245	270
Mail station in Lake Valley	0. 5	748. 1	6, 311	51	102
Johnson's Pass, in Sierra Nevada (summit)	2. 0	750. 1	7, 222	911	455

RETURN ROUTE.

Names of places.	Intermediate distances, in miles.	Total distance, in miles.	Altitudes, in feet, above the sea.	Difference of altitudes, in feet.	Grade, in feet, per mile.
Genoa	0	0	4, 824	0	0
Camp No. 2, Eagle Valley	13. 5	13. 5	4, 587	237	17
Chinatown	11. 5	25. 0	4, 360	227	19
Camp No. 3, on Carson River	5. 2	30. 2	4, 300	60	11
Camp No. 4, on Carson River	17. 8	48. 0	4, 154	146	8
Ridge between Carson River and Carson Lake	13. 2	61. 2	4, 460	306	23
Camp No. 5, on Carson Lake	11. 8	73. 0	3, 840	620	52
Camp No. 6, on Carson Lake	12. 2	85. 2	3, 840	0	0
Foot of pass	17. 0	102. 2	3, 960	120	7
Summit between Dry Flat Valley and Alkali Valley	1. 7	103. 9	4, 500	540	317
In Dry Flat Valley	1. 2	105. 1	4, 090	410	341
Ridge east of Dry Flat Valley	10. 2	115. 3	4, 460	370	36
Western base of Se-day-e Mountains	8. 8	124. 1	4, 665	205	23
Camp No. 7	10. 4	134. 5	5, 570	905	87
Ridge between Camp No. 7 and Dodge Valley	3. 0	137. 5	5, 900	330	110
Camp No. 8, Edward Creek, Dodge Valley	8. 2	145. 7	5, 486	414	50
Camp No. 9, western slope of Se-day-e Mountains	7. 0	152. 7	7, 022	1, 536	219
Se-day-e or Lookout Mountains (summit)	0. 6	153. 3	7, 260	238	396
Camp No. 10, Smith Creek, Woodruff Valley	7. 9	161. 2	6, 070	1, 190	150
In Woodruff Valley	7. 9	169. 1	6, 000	70	9
Divide between Smith Creek and Reese River	2. 1	171. 2	6, 483	483	230
In Reese River Valley	2. 5	173. 7	5, 965	518	207
Camp No. 11, on Reese River	8. 3	182. 0	5, 630	335	40
In Reese River Valley	6. 5	188. 5	5, 530	100	15
Pe-er-re-ah Mountains (summit)	4. 7	193. 2	7, 104	1, 574	335
Camp No. 12, eastern slope Pe-er-re-ah Mountains	5. 3	198. 5	6, 285	819	154
Camp No. 13, Won-a-ho-no-pe Creek	5. 0	203. 5	5, 811	474	95
In Won-a-ho-no-pe Valley	4. 8	208. 3	5, 543	268	51
Pah-rea range (summit)	6. 6	214. 9	6, 580	1, 037	157
Camp No. 14, Wons-in-dam-me Creek	14. 0	228. 9	6, 595	15	1

APPENDIX F.—*Table of distances, altitudes, and grades*—Continued.

RETURN ROUTE—Continued.

Names of places.	Intermediate distances, in miles.	Total distance, in miles.	Altitudes, in feet, above the sea.	Difference of altitudes, in feet.	Grade, in feet, per mile.
In Ko-bah Valley	9. 9	238. 8	6, 000	595	60
Camp No. 15, Clay Creek, Ko-bah Valley	6. 2	245. 0	5, 998	2	0
In Pah-ho-no-pe Valley	9. 3	254. 3	5, 820	178	19
Camp No. 16, McCarthy's Creek, Pah-ho-no-pe Valley	8. 0	262. 3	6, 184	364	45
We-ah-bah range (summit)	6. 2	268. 5	7, 270	1, 086	175
In Buell Valley	6. 2	274. 7	5, 863	1, 407	227
Camp No. 17, Buell Valley	3. 1	277. 8	5, 998	135	43
In Buell Valley	2. 5	280. 3	5, 813	185	74
Ridge between Buell Valley and Phelps Valley	12. 4	292. 7	6, 523	710	57
In Phelps Valley	4. 4	297. 1	6, 150	370	84
Ridge between Phelps Valley and Butte Valley	12. 7	309. 8	7, 103	953	75
Camp No. 18, near Summit Spring	0. 4	310. 2	7, 057	46	115
In Butte Valley	7. 5	317. 7	6, 268	789	105
Mon-tim range (summit)	8. 5	326. 2	7, 398	1, 130	133
Camp No. 19, eastern slope, Mon-tim range	3. 1	329. 3	6, 828	570	184
Camp No. 20, Steptoe Valley	14. 0	343. 3	6, 193	635	45
Western slope of Un-go-we-ah Mountains	10. 4	353. 7	7, 150	957	92
Do	1. 0	354. 7	6, 918	232	232
Camp No. 21, western slope of Un-go-we-ah Mountains	3. 0	357. 7	7, 443	525	175
Un-go-we-ah Mountains (summit)	1. 7	359. 4	8, 140	697	410
Eastern slope of Un-go-we-ah Mountains	7. 4	366. 8	6. 480	1, 660	224
Camp No. 22, Antelope Valley	6. 6	373. 4	5, 633	847	128
Tots-arr range (summit)	9. 9	383. 3	7, 060	1, 427	144
Camp No. 23, eastern slope Tots-arr Mountains	7. 2	390. 5	5, 927	1, 133	157
Camp No. 24, Crosman Springs, Crosman Valley	14. 8	405. 3	4, 920	1, 007	68
Camp No. 26, Plympton Springs, Crosman Valley	10. 5	415. 8	4, 814	106	10
Ridge between Crosman Valley and White Valley	9. 5	425. 3	5, 657	843	88
Camp No. 25, White Valley	10. 1	435. 4	4, 406	1, 251	124
Camp No. 27, White Valley	1. 5	436. 9	4, 350	56	37
House range (summit)	12. 1	449. 0	6, 674	2, 324	192
Camp No. 28, Chapin's Spring	2. 3	451. 3	6, 530	144	62
In Sevier Valley	7. 5	458. 8	4, 690	1, 840	245
Camp No. 29, Tyler's Spring	8. 0	466. 8	5, 992	1, 302	162
In Sevier Valley	8. 6	475. 4	5, 037	955	111
Summit of Thomas's range	6. 0	481. 4	5, 520	483	80
Base of Thomas's range	2. 0	483. 4	4, 840	680	340
Summit east of Thomas's range	6. 4	489. 8	5, 330	490	77
In the valley	6. 7	496. 5	5, 000	330	49
Camp No. 30, McDowell Mountains	7. 2	503. 7	5, 750	750	104
McDowell Mountains (west summit)	1. 0	504. 7	6, 000	250	250
In the valley between Camps No. 30 and No. 31	2 4	507. 1	5, 330	670	279
McDowell Mountains (east summit)	1. 9	509. 0	5, 830	500	263
Camp No. 31, Good Indian Spring	0. 4	509. 4	5, 771	59	147
Camp No. 32, William Spring, base of Mount Champlin	9. 2	518. 6	4, 558	1, 213	131
Camp No. 33, Prince Creek	8. 7	527. 3	5, 411	853	98
Summit between Prince Creek and Porter's Valley	1. 1	528. 4	5, 852	441	400
In Porter's Valley	2. 3	530. 7	5, 590	262	114
Summit between Porter's Valley and Brewer's Spring	2. 7	533. 4	6, 180	590	218
Camp No. 34, Brewer's Spring	2. 8	536. 2	5, 780	400	143
Oak Pass, Guyot range (summit)	5. 4	541. 6	7, 200	1, 420	263
Eastern slope of Guyot range	2. 0	543. 6	6, 190	1, 010	505
Camp No. 35, Meadow Creek, Rush Valley	6. 8	550. 4	5, 430	760	111
Summit between Meadow Creek and Rush Valley	3. 7	554. 1	5, 700	270	73
In Rush Valley	3. 8	557. 9	5, 140	560	147
Camp Floyd Pass	9. 5	567. 4	5, 234	94	9
Camp Floyd	4. 5	571. 9	4, 860	374	83

SIDE RECONNAISSANCES.

Names of places.	Altitudes, in feet, above the sea.
Salt Lake City, Upper street, near Brigham Young's	4, 300
Salt Lake	4, 170
Depôt camp in Round Prairie, about one mile below Torbert Cañon	5, 786
Mouth of Coal Creek Cañon, 5 miles from Depôt camp	6, 181
Coal Creek, 4 miles below summit, 7 miles up cañon	8, 400
Camp near head of Coal Creek, one-fourth mile from summit, and about 15½ miles from Depôt camp	9, 530
Summit of Uintah range, near head of Coal Creek	9, 680
Camp on Potts's Creek, 7½ miles from summit	8, 050
Five and one-half miles lower down, on Potts's Creek	7, 560
Junction of Potts's Creek with Duchesne	6, 814
On Duchesne Fork, 12½ miles below mouth of Potts's Creek	6, 280
Junction of Duchesne Fork with the Uintah	5, 345
Summit between Timpanogos River and Kansas Prairie	6, 955
In Kansas Prairie, on east branch of South Fork of Weber	6, 244
Camp on the East Fork of the Weber, one-eighth of a mile from camp of last fall	6, 760
Summit 7¼ miles from camp	8, 953
Head of branch of Porter's Creek, 1 mile from summit	8, 754
Fourteen and one-half miles from camp	8, 077
Summit on trail to White Clay Creek	7, 676
Crossing of West Fork of Bear River	7, 395
Summit west of Muddy Creek, 20 miles from Fort Bridger	7, 475

APPENDIX G.

ESTIMATE OF APPROPRIATIONS NEEDED FOR ROADS

IN THE

TERRITORY OF UTAH.

APPENDIX G.

ESTIMATE OF APPROPRIATIONS NEEDED FROM CONGRESS TO PROPERLY IMPROVE THE ROUTES IN THE TERRITORY OF UTAH.

The following letter from Bvt. Brig. Gen. A. S. Johnston, commanding the Department of Utah, to Col. Samuel Cooper, Adjutant-General United States Army, written August 26, 1859, in reference to the roads I have explored and opened in Utah, is here presented *in extenso*, both on account of the value set by the general on the routes I have opened, and of the intimation it gives of his having instructed me to examine certain portions of them with a view to the formation of an estimate for their further improvement:

HEADQUARTERS DEPARTMENT OF UTAH,
CAMP FLOYD, UTAH, *August* 26, 1859.

COLONEL: On Captain Simpson's return from his exploration westward (which has resulted, as has been heretofore reported, in his finding the shortest and best route from this valley to California via Carson Valley, and three hundred miles nearer than any other route from Salt Lake City), believing that the season was so far advanced that he would not be able to examine the country through to the eastern slope of the Rocky Mountains on the most direct course to Fort Leavenworth (which it was expected in the spring he would have had time to do after making the exploration westward), before winter, he was instructed, in furtherance of that object, to ascertain if a route with an easy grade could be found from near the source of the Timpanogos River across to the Uintah River, and down into Green River.

He proceeded to Round Prairie, on Timpanogos River, from which place he commenced his explorations; and I now have the gratification to communicate the result, which will be found in his report from camp No. 3, Round Prairie, Timpanogos Valley, by which the honorable Secretary of War will be informed of his successful exploration on the contemplated eastern route as far as Green River. This discovery, when the route is made passable by the removal of trees and brush, which are the chief obstructions, will enable travelers to avoid making the great detour south, which was unavoidably made by Colonel Loring on his march to New Mexico. I learn from the guide who was employed in the search for the route, that it can be continued without an obstacle, up White River, into either part in which are sources of the Plattes, Arkansas, and various affluents of Green River.

The only question, then, to be determined for the completion of an unexceptionable road from this camp on the most direct route to Fort Leavenworth, through the gold region, which will, from geological indications, no doubt, prove more productive on the western slope than on the eastern, is as to the practicability of getting down from the middle or South Park to the foot of the mountains on the east side.

All the information I have, concurs as to the fact of numerous pack-trails down the eastern slope, which encourages the hope that a good wagon-route may be found, or a good road can be constructed; and I respectfully suggest that for that purpose it would be better to conduct any future explorations from the east side of the mountain.

A part of the tide of emigrants has been turned on Captain Simpson's new road to California via Camp Floyd, and emigrants pass daily, and others with large herds of stock. The road is now well marked, and its natural state is sufficiently good, except a few places, at wide intervals, where the grade should be reduced, for which purpose I respectfully recommend that a small appropriation of money should be asked for from Congress, and also an appropriation for reconstructing a part of the road from this camp to Fort Bridger, which was graded by the Mormon population up the Timpanogos Cañon, and to re-imburse them for their outlay in making that part of the road, and for the expense of building a bridge across that stream, and for grading and bridging such other parts of the road as shall need it.

An estimate sufficiently accurate, upon which to found an appropriation, can be furnished by Captain Simpson, whom I requested to look at the route, on his return, with that view.

Whether the great national route in this region of the Rocky Mountains passes by Fort Bridger or the Uintah Pass, it must pass down the Timpanogos.

The Mormons now charge a heavy toll on the graded road down the cañon and across the bridge. This road should be free from charge to travelers.

The emigrants should not be subjected to the exactions which are made of them at this and several other places on the route. The Mormons and others who charge tolls, should be repaid their outlay, and travelers relieved from a tax which many are ill able to pay.

With great respect, your obedient servant,

A. S. JOHNSTON,
Colonel Second Cavalry, Bvt. Brig. Gen. U. S. A., Comd'g.

Col. SAMUEL COOPER, *Adjutant-General,*
Washington, D. C.

It will be noticed that in the above report General Johnston recommends that the Government re-imburse the Mormon people for the outlay they have made in the construction of a portion of my route from Fort Bridger to Camp Floyd, and that it thus be relieved from the heavy toll which is now exacted upon it. This portion extends for a distance of 12 miles up the cañon of the Timpanogos from its mouth, and the work was executed in the early part of the year 1858, before I explored and opened the route all the way through to Fort Bridger, in the fall of that year.

In order to ascertain the cost of the said turnpike, I addressed the following letter of inquiry to the Hon. W. H. Hooper, Delegate to Congress from Utah:

WASHINGTON, *December* 6, 1859.

SIR: Believing that it would be expedient to have the road from Fort Bridger to Camp Floyd, *via* the valley of the Timpanogos River, entirely free from toll, I respectfully ask for what amount the Timpanogos River Turnpike Company would sell out its interest in the turnpike portion of that road. I am anxious to know, so that if the amount asked is not unreasonably large, I can recommend to the Department an appropriation for the purpose.

I am, sir, very respectfully, your obedient servant,

J. H. SIMPSON,
Captain Topographical Engineers.

Hon. W. H. HOOPER,
Delegate from the Territory of Utah.

Mr. Hooper's reply.[*]

HOUSE OF REPRESENTATIVES,
Washington City, March 2, 1860.

DEAR SIR: On the 6th of last December I received a letter from you, making inquiry as to the amount the Timpanogos River Turnpike Company would sell out their road for. Not being able at the time to give the desired information, I stated to you in my reply that I would write to Utah upon the subject and learn whether the company were willing to sell, and upon what terms. From Utah, in answer to my communication on this subject, I learn that, by action of the last legislative assembly, the cañon-road became the property of the Territory; that there was expended in the construction of said road eighteen thousand nine hundred and ninety-seven dollars and sixty-one cents, ($18,997.61,) and for labor in locating the road and supervising the expenditures thereon, one thousand dollars, ($1,000,) making a total cost of nineteen thousand nine hundred and ninety-seven dollars and sixty-one cents, ($19,997.61.)

Should the Government wish to purchase the cañon-road at the before-named amount of total cost, and make the requisite appropriation for so doing, doubtless the Territory will be willing to sell said road for that sum.

I am, sir, very respectfully, your obedient servant,

WM. H. HOOPER.

Capt. J. H. SIMPSON,
Topographical Engineers.

Having now presented some of the grounds for the following estimate, I am prepared to submit it, premising that as the turnpike portion referred to in Mr. Hooper's letter has been, a great deal of it, excavated from the solid rock, and includes an excellent bridge over the Timpanogos, I do not consider the amount expended by the Territory in its construction extravagant.[†]

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[*] The original transmitted through Bureau of Topographical Engineers, August 2, 1860, to Hon. Secretary of War.

[†] The details of the routes—at what points they should be improved, and the nature of the improvements—will be found given in my journal of explorations above; and in my report of December 28, 1858, to General Johnston, of my exploration and opening of the new route from Camp Floyd to Fort Bridger *via* Timpanogos Cañon and White Clay Creek. This last report constitutes Sen. Ex. Doc. No. 40, 35th Cong., 2d Sess.

Estimate of cost of the construction and improvement of Captain Simpson's wagon-road from Fort Bridger to California, via White Clay Creek, Timpanogos Cañon, Camp Floyd, and his more southern or return route over the Great Basin.

For portion of road from Fort Bridger to divide between Silver Creek and Timpanogos River, to be expended principally in White Clay Creek Valley	$20,000
To buy out the interest of the Territory of Utah in the turnpike portion of the road, in Timpanogos Cañon, as above	19,997
To improve said turnpike portion by widening it and elevating it sufficiently in places above the contingency of high water in the Timpanogos, and for generally repairing the road all the way from the divide between Silver Creek and the Timpanogos River to Camp Floyd	10,003
Total required for portion of road from Fort Bridger to Camp Floyd	50,000
For route from Camp Floyd to Genoa, *via* General Johnston's pass of the Guyot range, and Captain Simpson's more southern (or more northern) route across the Great Basin (as the War Department may direct), and for making water-tanks	50,000
To carry the road across the first or most eastern range of the Sierra Nevada, from Genoa to Lake Valley, either by the west branch of Carson River, or the Daggett trail, as may be found most expedient by the engineer in charge, and in the latter case the road to join the old one at the summit of Johnston's Pass, or where most advantageous	30,000
Total amount required for the whole road from Fort Bridger to Johnston's Pass	130,000

In the foregoing estimate I have assumed that it would be best for the Government to improve my more southern route over the Great Basin. I have done this for the reason that though this route is 29 miles longer than my more northern route, yet the grades of the former are better, and the grass, timber, and cultivable soil upon it more abundant, and the water equally if not more abundant. Should, however, the Government prefer to improve the more northern route, on which the mail and pony-express are now running, the above estimate will hold equally good, only instead of the phrase "more southern route," that of "more northern route" should be used. Indeed, it might in the low appropriation be left optional with the War Department to apply the money on either route as it might deem best.

So much for the road from Fort Bridger to California. By referring to my journal, under date of August 12, 1859, it will be noticed that I explored a very favorable pass from the valley of the Timpanogos to that of Green River, over the Uintah range of mountains. This pass can be made available for wagons by the removal of the timber in Coal Creek Valley, on the north side of the pass; by the removal of the willows and construction of some causeways in Potts' Creek Valley, on the south side of the pass; and the filling up of some of the gullies in the valley of the Duchesne's Fork. The cost of this would be, say, $20,000. This done, the valley of the Duchesne's Fork of Uintah, and possibly of Green River, would be opened to settlement, and the result eventually follow of a wagon-road communication all the way through from the valley of Great Salt Lake, by the way of the Timpanogos, Coal Creek, Potts' Creek, Duchesne's Fork, the Uintah River, and White River, to Breckenridge, at the head of Blue River, in the middle park of the Rocky Mountains; from which to Denver City, according to the subjoined letter from Hon. B. D. Williams, there is probably at this date a wagon-road. This route, it will be perceived, will, in connection with mine across the Great Basin, furnish much the shortest route across the continent from the Missouri River, and in addition be of incalculable service in the interchange of commodities between the Mormon population and the people of the gold region about Pike's Peak.

To sum up, Congress should appropriate:

For the road above specified, from Fort Bridger to the summit of Johnston's Pass of the Sierra Nevada	[*]$130,000
For the road from Round Prairie, in Timpanogos Valley, to the mouth of Duchesne's Fork, by the pass of the Uintah range, at the head of Coal Creek	20,000
And for a thorough exploration of the country between the mouth of Duchesne's Fork and Denver City, for the shortest and best route across the Rocky Mountains between those points	20,000

I now give the letter of Mr. B. D. Williams, above referred to:

WASHINGTON CITY, D. C., *January* 18, 1860.

SIR: At your request I write you on the subject of a wagon-road from Denver City, Jefferson Territory, due west to Great Salt Lake City.

I would state that I have just received from Mr. George E. Spencer a plat of a town called Breckenridge, situated at the mouth of French Creek, which empties into Blue River. This point is where the gold was discovered last fall and is about one hundred miles from Denver City nearly west, and about sixty miles beyond the main divide of the Rocky Mountains.

A short history of the prospecting of this country, perhaps, may be interesting. About the month of August last some straggling miners crossed the "snowy range" in search of gold, and, after prospecting for a short time, a portion returned to Denver City for provisions, and made it known that they had made new and good discoveries of gold; at once quite a rush took place for the newly-discovered fields, which were thoroughly prospected before the cold weather set in, so as to satisfy all that there was no humbug in this matter. Several hundred wagons crossed the range in the fall and returned, as late as the 10th of October. John N. Ming, an enterprising merchant at Auraria, fitted out and sent over some wagon-loads of goods which met with ready sale. Since that time there has a company of men obtained from the legislature a charter to build a wagon-road to said point, and are now engaged in prosecuting the same to an early completion. They assure me that they will, by the 1st day of May, have the road fully completed, and that six yoke of oxen can haul 5,000 pounds over the mountains to said point. I am informed that there is but little impediment in getting a good road on to White River.

Then follow that river to where it empties into Grand River, and which is described by Captain Frémont in 1845, I feel satisfied in stating that there can, with but little expense, be a good and permanent wagon-road got, which will be, as you can easily see, about the fortieth parallel of latitude. I cannot speak with the same certainty in reference to the practicability of the road beyond Breckenridge as I can on this side. You will understand that Breckenridge is in the Middle Park beyond the range of the mountains.

I hope that there will be an appropriation made to explore this country, and open a good road across this country. I am assured that it is about one hundred miles nearer than the old road by Laramie, and I am assured by those who know the country well that the snow will not impede the travel in winter.

Hoping this information will be of some benefit to you, I am, respectfully, yours,

B. D. WILLIAMS, *Delegate Jefferson Territory.*

Capt. J. H. SIMPSON, *Topographical Engineers.*

All of which is respectfully submitted.

J. H. SIMPSON,
Captain Topographical Engineers.

DECEMBER 29, 1860.
Col. J. J. ABERT, *Chief Corps Topographical Engineers.*

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[*] I have been informed that the people of California and Western Utah, since my exploration, have been engaged in making the road from Genoa, across the east branch of the Sierra Nevada, by the Daggett trail, to Johnston's Pass. If so, and they have completed it, $30,000 of the above estimated $130,000 may be deducted.

EXPLORATIONS ACROSS THE GREAT BASIN OF UTAH.

APPENDIX H.

MAGNETIC OBSERVATIONS
AND
RESULTS.

APPENDIX H.

MAGNETIC OBSERVATIONS AND RESULTS.

The following table of the magnetic dip (or inclination), declination (or variation), and horizontal intensity of various points along the route from Fort Leavenworth, *via* Fort Kearney, Fort Laramie, and the South Pass, to Fort Bridger, and thence, *via* Camp Floyd, by my new more northern route, to Genoa, in Carson Valley, will not be without interest and value to the physicist as well as surveyor.

The instruments used and experiments resorted to, as well as the method of attaining the ultimate values of the magnetic elements, will be found stated in the following communication of Lieutenant Putnam, Topographical Engineers, my assistant, by whom the observations were chiefly made. The Jones unifilar magnetometer used by us was the one Dr. Kane had with him on his second Grinnell expedition to the Arctic Ocean, in search of Sir John Franklin; and though it was not altogether such in its form or capabilities as I could have wished, yet, for the reason that I could procure no other and there was not time to have one made, I could not do better than to take it. For a paper on the mode of conducting the experiments with this instrument, and with the dip circle (or inclinometer), as well as of obtaining the mathematical value of the elements involved, which has been of great service to us in facilitating our work, I am indebted to Mr. J. E. Hilgard, of the Coast Survey, whose zeal in this branch of scientific research is not greater than his ability, and to whom I have now to express my grateful acknowledgments.

In comparing the declination by the magnetometer (converted into a declinometer) and compass observations on Polaris, as given in the subjoined table, it will be noticed that there is a considerable difference between the results obtained; and that in one instance (at Fort Bridger) it reaches as much as 2° 6′ 50″. At first I was disposed to reject the declinations as shown by the declinometer altogether, supposing that this great difference was owing to a defectiveness on the part of the instrument, but perceiving, on examining the reductions of Dr. Kane's observations in the months of January, February, and March, 1854, at Van Rensselaer Harbor, by Mr. Charles A. Schott, assistant, United States Coast Survey, that he gives the following as a classification of the daily ranges according to their magnitudes, I have come to the conclusion, as the observations were taken with a great deal of care, that the differences have arisen doubtless from the observations by the declinometer having been taken during the day, and those by compass during the night, in connection with the delicate nature of the declinometer, and that the results, therefore, as scientific facts, are worthy of record.

Mr. Schott's classification of Dr. Kane's 17 daily observations is as follows:

Daily range less than 1°	1
Daily range between 1° and 2°	6
Daily range between 2° and 3°	4
Daily range between 3° and 4°	3
Daily range between 4° and 5°	3
Daily range greater than 5°	0

The observations we made were quite numerous, but as they are filed in the Bureau of Topographical Engineers for reference, it is thought best not to incumber the report with them, but only to subjoin a set of each as a specimen of the rest. The results, however, are presented below in a tabulated form, and also graphically on the small charts of the declination and inclination of the needle herewith (see Plate). These charts, I would remark, so far as the data shown across the continent, from Fort Smith, Ark., to the cañon of Chelly, in New Mexico, and from Fort Leavenworth to Genoa, in Carson Valley, are concerned, are an extension by me of the latest charts on this subject from the United States Coast Survey. The Superintendent of the Coast Survey, Prof. A. D. Bache, has kindly furnished me with their latest magnetic charts, and it is a gratification to me, by my explorations in 1849, from Fort Smith, via Santa Fé, to the cañon of Chelly, and by my recent expedition from Fort Leavenworth to Genoa, to be thus able to supply a great deal of magnetic data, which will extend our knowledge of this element over a larger area of our country, and make these charts still more useful.

In addition to the above I would make the following remarks in relation to the electric condition of the atmosphere in the Great Basin. I have noticed that my flannel, when cast off at night before retiring to rest, would evince, by a crackling sound, that it was highly charged. This would frequently be the case in combing one's whiskers, or handling a bear-skin. All this doubtless points to the very dry state, and, therefore, non-conducting power, of the air, and the non-escape of the electric fluid from terrestrial bodies except by the proximity of others.

I would also extract the following from my report of my explorations in the fall of 1858, in Utah, as bearing on this subject:

"It is astonishing to notice the effect of the whirls and gusts of wind upon the magnetic needle, or, more properly speaking, to see the action of the magnetic needle at the time these whirls and gusts are in development. The fact of these disturbances appearing together does not necessarily point to the same cause producing both, but makes it strongly probable that the cause is one and the same in both cases. The needle, whenever these gusts and whirls are in exhibition, would stick either to the north or south end of the bottom of the box, and no change of position could make it stir. Sometimes the effect would be to disturb the needle very much, and to make it point indifferently to any point of the compass. When, however, the gusts would cease, the needle would act normally as usual."*

A somewhat similar phenomenon exhibited itself subsequently at Camp Floyd, in March, 1859, when, however, the weather was fair, though there was some little wind. I was verifying some observations for magnetic declination, by placing a surveyor's compass, on the meridian, immediately over the transit station, with the intention of reading the declination directly from the needle. The needle, however, I perceived, would not traverse. Supposing the glass cover pressed upon it, I took it off, when the needle moved freely and normally. Finding, however, the wind agitated it too much to allow it to come to a state of rest, I placed the glass back, and found, on a closer examination, that it did not touch the needle. But still the needle would not traverse. I again took off the glass and the needle again traversed freely. I then extended the glass to its place on the needle *gradually*, when I noticed the effect of the proximity was to paralyze the needle, and *that* in proportion to the proximity, so that when the glass was in its place the motion of the needle was entirely paralyzed. The cause, then, of the needle not traversing was the influence of the glass cover in its then abnormal state. Finding the compass to be of no service for the purpose in view, I substituted another in its place, which I found to work well without any signs of disturbing agency. Some days after this I had occasion to again use the first-named compass, when I found the needle acted normally.

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* See Senate Ex. Doc., No. 40, 35th Cong., 2d session, p. 28.

The cause, then, of the disturbance above referred to was on account of the accidental abnormal state of the glass cover at the time, and not from any permanent disturbing cause. It is not understood, however, what caused the abnormal condition of the glass of the first large surveyor's compass. Both it and the second surveyor's compass were taken out of their respective boxes just before using them, and the state of the wind was by no means one of irregularity. Besides, if it had arisen from the atmosphere, what affected the one ought to have affected the other, as they had both been subjected to the same handling.

I have thought it proper to note these irregularities in the magnetic needle on account of its bearings upon the accuracy of surveys depending upon its normal state, and the necessity of watching to see that no such disturbing causes are in operation at the time bearings are taken with it. I think there can be no doubt that frequently irregularities, which have been attributed to local attraction, have arisen from this source, and not from the presence of metallic substances to which they have been ascribed; and it is very probable, too, that these irregularities, in all such cases, have been but temporary.* (See, also, Appendix E, pages 78 and 79.)

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* Since writing the foregoing I have become acquainted with Mr. W. H. Paine, surveyor and civil engineer, of Sheboygan, Wisconsin, who has furnished me with the following letter, corroborative of the inexplicable character of the abnormal condition of the magnetic needle at certain periods:

"WASHINGTON, D. C., *January* 9, 1861.

"DEAR SIR: Agreeably to your request I will briefly mention some of the observations and experiments which I have made relative to some of the disturbing influences affecting the magnetic needle as used in the surveyor's compass.

"An unfavorable electrical state of the glass covering the needle is a very common cause of disturbance, and its effects are often mistaken for those of local attraction, as it is difficult to determine, by mere observation, whether the one end of the needle is elevated by attraction or the other depressed by a similar cause.

"And when the elevation of one end of the needle from this cause is but slight, the needle is often supposed to be in its normal state when it is not.

"Whenever I have had occasion to use a compass, for several years past, I have proceeded as though I suspected some disturbing influence was having an effect upon the needle, and often, after allowing the needle to become apparently settled, have found that, by breathing upon the glass, or moistening my fingers and bringing them in contact with it, the needle would change its position both in relation to its dip and declination, thus showing that the electric state of the glass affected the needle when it was least suspected.

"For more than two years past I have used a cover or guard, so constructed as to prevent the glass from coming in contact with the clothes of the person carrying the compass, or with other substances, and find that now the needle is but comparatively seldom in an abnormal state.

"Still, there are times when the needle is disturbed, and on two occasions, in particular, I was unable to remove the

I would also draw attention to the fact, which the tables will show, that the usual law which governs the variations in the declination of the needle does not obtain between Fort Bridger and Genoa. At Bridger (longitude 110° 23′ 47″), the declination obtains a maximum of 17° 30′ E.; at Simpson's Spring (longitude 112° 47′ 18″), farther west, it declines to 15° 30′ E.; and still farther west, at Genoa (longitude 119° 40′ 30″), it again has increased to 16° 40′ E.

Mr. Francis A. Bishop, in his report on the Humboldt division of the Fort Kearney, South Pass, and Honey Lake road, speaks of the same thing. His language is: "It will be observed that the magnetic variation increases in going from the Honey Lake (longitude 120° 15′) to the City Rocks (longitude 113° 45′) from 16° 00′ 15″ E. to 17° 00′ 20″ E., contrary to the general law of magnetic variations.[*]

Captain Whipple's table of magnetic results shows the like irregularity to obtain near the parallel of 35° of north latitude, between Albuquerque (longitude 106° 37′ 52″) and Soda Lake, the sink of the Mojave River (longitude 115° 58′ 46″), though not to the same degree.[†]

The following is Lieutenant Putnam's communication, referred to above:

SIR: Herewith is presented the results of observations for magnetic elements, *en route* from Fort Leavenworth to Genoa, Carson Valley, in 1858–'59.

The observations for dip and declination were usually made at intervals of about 50 miles along the route; those for intensity could be taken only at a few points, the nature of the observation being such as to require much time and care to determine the necessary data.

The instrument used for obtaining the declination and intensity was the "unifilar magnetometer No. 3;" the dip circle made by Gambey was used for finding the dip or inclination.

To avoid the trouble of locating the meridian, the work of at least one night under favorable circumstances of weather, the magnetic azimuth of the sun was taken, while at the same time another observer measured its altitude with the sextant, and a third noted the time by the chronometer. These data were sufficient, by means of a simple formula, involving the co-latitude of the place, the sun's zenith and north polar distances, to compute the true azimuth, which, with the magnetic azimuth already found, gives the desired declination.

The observations for intensity were of two kinds: experiments of vibration, and experiments of deflection.

1. The experiments of vibration consist in finding the time of one vibration of the magnet, which was suspended horizontally by means of a single fiber of silk. This is best done by noting the time of a large number of vibrations, say 200, and dividing this time by the number.

2. The experiments of deflection, which consist in measuring the angle u, through which the suspended magnet is deflected by another magnet placed at right angles to and a certain distance from the first.

By means of the quantities (t and u) thus found, and the formulas, $m x = \frac{\pi^2 k}{t^2}$, and $\frac{m}{x} = \frac{1}{2} r^3 \tan u$, (in which x is the horizontal component of the magnetic force, m the magnetic moment of the magnet, k its moment of inertia, and r the distance of the deflecting from the suspended magnet in feet and tenths), the value of x may be found.

The dip was obtained as follows: The plane of the circle was first put in the magnetic meridian either by the use of the ordinary compass for the purpose, or by giving it such a position that the needle would stand vertically; this corresponds to a position of the vertical circle at right angles to the magnetic meridian, and by means of the graduated horizontal circle it can be at once brought into the magnetic meridian. In this position both ends of the needle are read. It is then lifted from the Y's, and turned half around its longer axis, replaced, and read again; the horizontal circle is then revolved 180° around its vertical axis, and ends of the needle read again; then the needle is once more turned about its longer axis, and reading taken as before. The same process precisely is gone through with a second needle. If time allows, the poles of each are reversed, and the observation repeated with both. Whenever this is done

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cause of disturbance by the methods previously resorted to. On both of these occasions other phenomena indicated a highly electrical state of the atmosphere, and to be certain that local attraction was not exerting any influence, I have since passed over the same lines without experiencing any difficulty, or witnessing any of the phenomena then so apparent. I do not attempt to account for the occurrence of this phenomena, but merely submit the facts in the case, although my opinion is that currents of electricity in the air had something to do in the case.

"Yours, very respectfully,

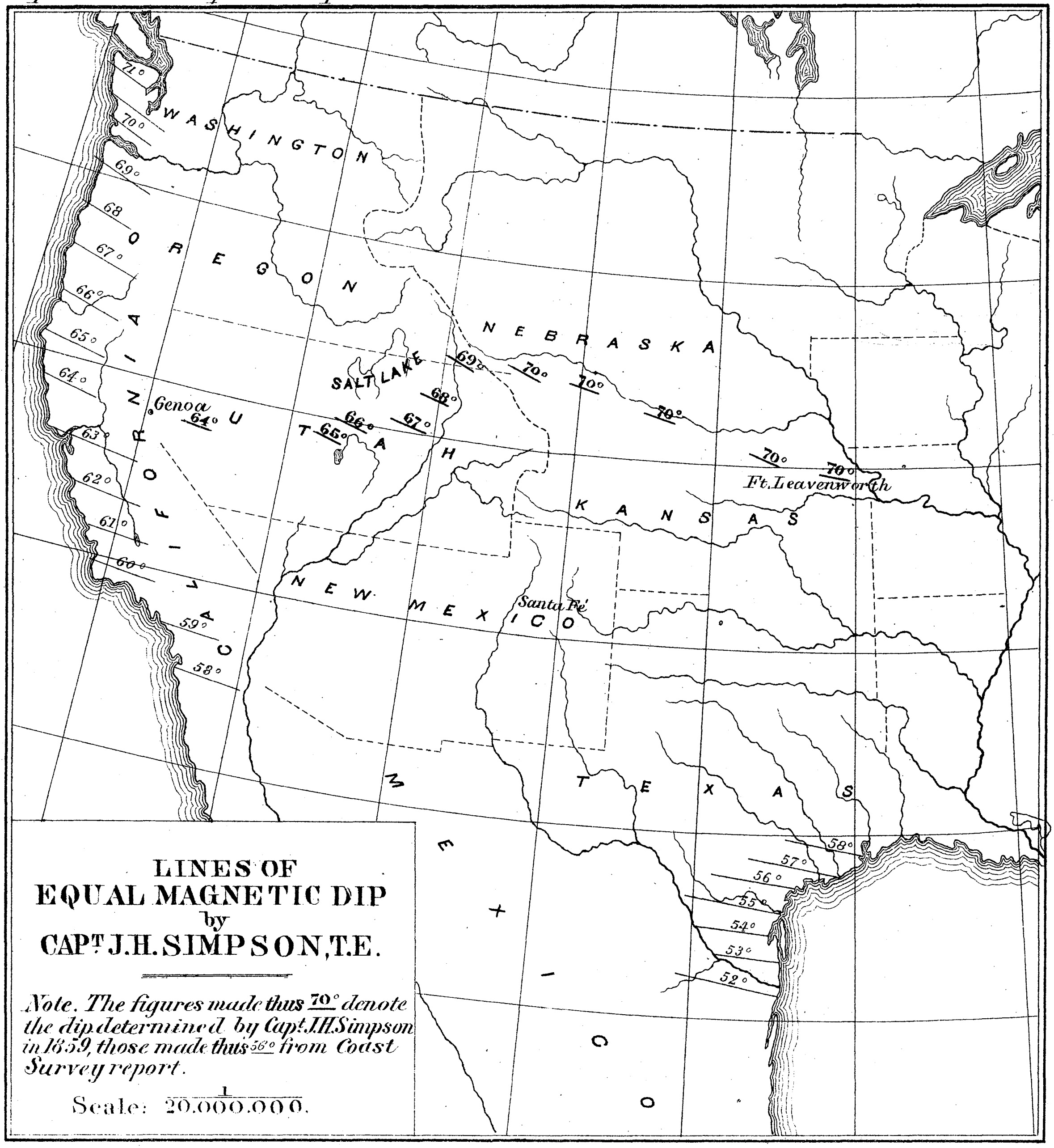
"WM. H. PAINE.

"Capt. J. H. SIMPSON."

[*] See Ex. Doc. No. 108, H. R., 35th Cong., 2d sess., p. 44.

[†] See Appendix "G," Pacific Railroad Reports, vol. iv.

Explorations of Capt. J.H. Simpson, T.E. U.S.A. in 1859. *Plate F.*



LINES OF
EQUAL MAGNETIC DIP
by
CAPT. J.H. SIMPSON, T.E.

Note. The figures made thus **70°** *denote the dip determined by Capt. J.H. Simpson in 1859, those made thus 56° from Coast Survey report.*

Scale: $\frac{1}{20.000.000}$.

a mean of thirty-two observations is obtained, and the errors of eccentricity, imperfect balancing of the needles, and imperfect adjustment of the pivots, are eliminated.

After reaching Washington a constant correction was determined for the declination (rendered necessary by defects of the instrument), facilities for this purpose being obligingly afforded by Mr. Schott, of the Coast-Survey.

I am, very respectfully, your obedient servant,

H. S. Putnam,
Lieutenant Topographical Engineers.

Capt. J. H. Simpson,
Corps of Topographical Engineers, United States Army.

Table showing the value of the magnetic dip, declination, and horizontal intensity at various points between Fort Leavenworth, Kans., and Genoa, Carson Valley, Nevada, as determined in the explorations of Capt. J. H. Simpson, topographical engineers, in 1858 *and* 1859:

Date.	Place.	Latitude (north).			Longitude (west of Greenwich).			Declination by magnetometer (east).			Declination by compass and observation on Polaris (east).			Dip or inclination, by dip-circle.		
		°	′	″	°	′	″	°	′	″	°	′	″	°	′	″
May 6, 1858	Fort Leavenworth	39	21	14	94	40	00	11	59	15				69	28	51
June 5, 1858	Little Muddy Creek	39	35	00	95	34	00							69	34	45
June 8, 1858	Vermillion Creek	39	57	00	96	16	03	12	36	42				70	08	59
June 9, 1858	Big Blue River	40	00	00	96	35	00	15	09	46				69	19	30
Oct. 8, 1859	Rock Creek	40	11	00	97	02	00				13	06	00			
June 12, 1858	Big Sandy River	40	12	00	97	12	00	14	39	00				69	32	37
June 15, 1858	Little Blue River	40	15	00	98	10	00	14	43	42				69	50	33
Oct. 5, 1859	Elm Creek	40	30	00	98	30	00				13	18	00			
June 29, 1858	Fort Kearney	40	38	00	98	56	00	14	38	00	14	00	00	70	14	52
July 7, 1858	Camp No. 20	40	40	00	99	54	00	14	16	49				69	37	11
Sept. 30, 1859	Platte River	40	58	30	100	35	00				14	32	00			
July 11, 1858	Camp No. 22	41	05	00	100	50	00	12	04	57				69	46	07
July 18, 1858	Camp No. 25	41	03	00	101	50	00	14	20	44						
July 22, 1858	Ash Hollow	41	21	00	102	03	00							70	02	27
Sept. 24, 1859	North Platte	41	23	00	102	15	00				16	26	00			
July 26, 1858	Chimney Rock	41	43	00	103	30	00							70	15	11
Sept. 20, 1859	North Platte	41	58	00	104	00	00				16	36	00			
July 30, 1858	Fort Laramie	42	12	00	104	31	00	14	24	36				70	02	36
Aug. 7, 1858	La Bonté River	42	35	00	105	22	00	18	22	35				70	15	11
Aug. 11, 1858	Five miles west of Deer Creek	42	53	00	105	57	00	18	28	22				70	28	51
Aug. 15, 1858	Greasewood Creek	42	40	00	107	07	00	20	23	39				70	01	15
Aug. 17, 1858	Sweetwater River	42	38	00	107	25	00	19	41	05				69	53	15
Aug. 23, 1858	......do	42	30	00	108	35	00	19	56	24				69	34	48
Aug. 26, 1858	Little Sandy Creek	42	15	00	109	40	00	20	44	17				68	59	33
Sept. 3, 1858	Fort Bridger	41	20	23	110	23	47	19	36	50	17	30	00	68	05	07
Sept. 11, 1858	Snyder's Creek	40	56	00	111	42	00	19	54	57				67	10	04
April 21, 1859	Camp Floyd	40	13	18	112	08	07	16	34	48	17	10	08	66	29	10
May 4, 1859	Simpson's Spring	40	01	55	112	47	18	16	42	10	15	30	00	66	53	55
May 8, 1859	Sulphur Spring	39	40	36	113	46	19	15	55	25				65	07	07
May 10, 1859	Antelope Valley	39	46	36	114	12	22	16	47	16	16	50	00	65	19	14
May 14, 1859	Eagan Cañon	39	51	46	114	58	15				16	47	00			
May 16, 1859	Huntingdon Spring, east side Ruby Valley	40	00	29	115	19	11	18	05	59				65	25	25
May 19, 1859	Cho-kup Pass	39	53	50	115	44	36	17	02	29				65	19	15
May 22, 1859	Ko-bah Valley	39	44	34	116	10	29	16	43	33	15	55	00	64	55	44
May 28, 1859	Reese River	39	29	29	117	02	41	17	03	10	16	10	00	64	24	52
June 5, 1859	Carson Lake	39	23	37	118	30	01	17	10	42				64	01	59
June 8, 1859	Big Bend, Walker's River	39	08	39	118	56	00	16	55	41				63	36	41
June 15, 1859	Genoa, Carson Valley	38	59	33	119	40	30	16	17	50	16	40	00	64	11	31

The observations for magnetic intensity give for x, the horizontal component of the earth's magnetic force, as follows: At Fort Leavenworth, Kans., May 10, 1858, x=4,368; at Fort Kearney, Kans., June 24, 1858, x=5,0194; at Camp Floyd, Utah, March 25, 1859, x=5,3750.

[Form used.]

Horizontal intensity.—Experiments of vibration.—Camp half-mile south of Fort Leavenworth, May 10, 1858.—*Magnet* A 67, *Inertia ring,* Z.—*Chronometer* 1821.

Number of vibrations.	Time.	Temperature.	Extreme scale readings.		Time of 200 vibrations.	Calculations.—Observed time of 200 vibrations = 752s. 3. Time of vibrations = 3s. 76. $m x = \frac{\pi^2 k}{T^2}$		
	h. m. s.	°			m. s.			
0	4 03 21	67	180	390	....	T	0. 57518	
10	4 03 58	......	......	......	....	T^2		
20	4 04 35	......	......	......	....		1. 15036	
30	4 05 12	......	......	......	....	$\pi^2 k$	1. 33940	
40	4 05 50	......	......	......	....			
50	4 06 28	......	......	......	....	$m x$	0. 18904	
100	4 09 38	......	......	......	....	$* m$	9. 54876	
200	4 15 55	......	280	320	12 34			
10	4 16 31	......	......	......	12 33	x	0. 64028	=4. 368
20	4 17 07	......	......	......	12 32			
30	4 17 44	......	......	......	12 32	$\frac{m}{x}$	8. 90849	
40	4 18 22	......	......	......	12 32			
50	4 18 59	......	450	140	12 31	$m x$	0. 18904	
	Means ..	......	......	......	12 32	m^2	9. 09753	
						m	9. 54876	

Observer, Capt. J. H. Simpson.

[Form used.]

Horizontal intensity.—Deflections with theodolite magnetometer.—Camp, ½ *mile south of Fort Leavenworth, May* 19, 1858.—*Magnet* A 67, *deflecting at right angles to magnet* I 10, *suspended.*

[Distance r = 1. 3 feet. Log. = 0. 11394.]

Magnet.	North end.	Circle readings.				Circle readings.			
		No.	A	B	Mean.	No.	A	B	Mean.
			° ′ ″	′ ″	′ ″		° ′ ″	′ ″	′ ″
East.	E.	1	70 53 20	52 00	52 40				
	W.					2	62 51 20	51 00	51 10
	E.	3	70 49 45	48 40	49 10				
	W.					4	62 52 00	45 40	48 50
	E.	5	70 49 40	49 00	49 20				

Mean 8° 50′ 23″

Magnet.	North end.	No.	A	B	Mean.	No.	A	B	Mean.
			° ′ ″	′ ″	′ ″		° ′ ″	′ ″	′ ″
West.	W.					6	62 49 00	48 00	48 30
	E.	7	70 53 00	52 20	52 40				
	W.					8	62 49 20	48 00	48 40
	E.	9	70 54 00	53 20	53 40				
	W.					10	62 49 00	48 00	48 30

Mean 8° 04′ 30″

					Logarithms.
	°	′	″		
Mag. E. $2 u$ =	8	50	23		
Mag. W. $2 u$ =	8	04	30		
Mean	8	27	26. 5	½	9. 69897
u =	4	13	43. 25	r^3	0. 34183
Beginning time 11.25 a. m.; temperature 82°.5.				Sin. u	8. 86769
Ending time 2.40 p. m.; temperature 74°.				$\frac{m}{x}$	8. 90849

Observer, Capt. J. H. Simpson.

[Form used.]

Magnetic dip.—Genoa, Nevada, June 14, 1859.—*Needle No.* 1.—*Observer, Lieutenant Putnam.*

A. S., OR UPPER END.							
Circle east.				Circle west.			
Face east.		Face west.		Face east.		Face west.	
A.	B.	A.	B.	A.	B.	A.	B.
° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
63 15	63 14	64 2	64 4	64 9	64 8	64 41	64 37
With poles reversed.							
63 2	63 2	62 31	62 29	65 34	65 33	64 5	64 4
63° 8′ 15″		63° 16′ 30″		64° 51′		64° 21′ 45″	
63° 12′ 22″				64° 36′ 22″			
63° 54′ 22″							

Needle No. 2.—*Observer, Lieutenant Putnam.*

A. S., OR UPPER END.							
Circle west.				Circle east.			
Face west.		Face east.		Face west.		Face east.	
A.	B.	A.	B.	A.	B.	A.	B.
° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
63 16	63 14	63 49	63 48	64 36	64 38	64 13	64 14
With poles reversed.							
65 4	65 2	64 46	64 45	64 55	64 56	65 11	65 12
64° 09′		64° 17′		64° 46′ 15″		64° 42′ 30″	
64° 13′				64° 44′ 22″			
				64° 28′ 41″			
				63 54 22			
				2)128 23 03			
Grand mean or magnetic dips				64 11 31			

[Form used.]

Magnetic declination or azimuth between the true and magnetic meridian.

Camp one-half mile south of Fort Leavenworth, Kansas, May 25, 1858.—Unifilar magnetometer No. 3.—Magnet I 10.

From magnetic station to magnetic south point (mirror above):

	°	′	″
Limb of magnetometer reads, first vertical	67	53	40
Limb of magnetometer reads, second vertical	247	52	20
Mean	67	53	00

(Mirror below :)

	°	′	″
Limb of magnetometer reads, first vertical	70	07	40
Limb of magnetometer reads, second vertical	250	07	20
Mean	70	07	30
Grand mean of magnetic south point	69	00	15
True south point reads, first vertical	57	01	20
True south point reads, second vertical	237	00′	
Mean	57	01	00

Difference of mean readings or magnetic azimuth 11° 59′ 15″ E.

Lieut. H. S. Putnam, Observer.

NOTE.—In the above case the true meridian had been determined by an observation on Alioth (*e, Ursæ Majoris*) and Polaris, and marked on the ground. In our observations on the march the magnetic azimuth of the sun was observed and the true azimuth (or meridian) determined from the known time, latitude, and declination.

APPENDIX H H.

RAILROAD-ROUTES

FROM

THE ATLANTIC TO THE PACIFIC OCEAN.

APPENDIX HH.

RAILROAD ROUTES FROM THE ATLANTIC TO THE PACIFIC OCEAN.

[BY CAPT. J. H. SIMPSON, CORPS TOPOGRAPHICAL ENGINEERS, U. S. ARMY.]

As it may be expected of me, on account of my explorations over different portions of the country lying between the Arkansas and Mississippi Rivers and the Pacific Ocean, that I should express my views in relation to the great question of one or more railroads across the continent, I do not know how I can better do so than to include, as a portion of my report, the following letter which I addressed on this subject to a citizen of Buffalo, January 20, 1859, when I was at Camp Floyd. At that date I had not made the explorations I have since over the Great Basin of Utah, and I will, therefore, premise that what I have said in this letter, in relation to the middle or Beckwith railroad route, I am constrained, from the experience I now have, to modify, so far as to state that, while I do not consider (as I have reported in the introduction to my report) my route across the Great Basin a railroad route, yet I do believe that that suggested by Captain Beckwith, from the south end of Great Salt Lake to the head of the Humboldt, and thence down its valley at least to where it should leave said valley to strike and cross the Sierra Nevada, will be found to be practicable. What should be the line from the Humboldt to and across the Sierra Nevada is a question which, probably, is more open to doubt; though I should gather, from Captain Beckwith's report, that even in this section his grades do not preclude the practicability of the route.*

I will also premise that, as the accumulation of the snows in the high mountain-passes is more due to successive snow-storms, and non-melting of the snow, and thus every storm adding something to the quantity, than to a fall of it at any one period, which might, as often as it occurred, be removed with probably no very great difficulty, I do not consider the snow in the mountains as great a hinderance to a railroad across the continent, on the middle route, as my letter below indicates. With these modifications, I now present the letter as expressing my present views on this subject.

Railroad across the United States, from the Atlantic to the Pacific.

CAMP FLOYD, UTAH, *January* 20, 1859.

DEAR SIR: Your letter of the 9th ultimo I had the gratification to receive by the last mail. You request of me my views in relation to the Pacific Railroad, which you are pleased to think my familiarity with the country and long consideration of the various projects suggested qualify me to give. My experience in relation to this subject consists in my having made, with Captain Marcy, in 1849, the first survey of the Fort Smith and Zuni route, as far as the Rio Grande, each taking notes for the purpose; thence, to Zuni, I was alone engaged in the reconnaissance, and in my report of this survey I pointed out, for the first time, the great importance to the Government, on the score of grade and distance, of ordering a further reconnaissance of a route in the same direction all the way to the Pacific. My reports of both these explorations have been published by the Government, and they are available to those who may take any interest in the history of explorations in this country. My views in relation to a Pacific railroad differed very much from those of Colonel Frémont and other officers of the Government; but as they did not flatter the public mind into the belief that the project was one of immediate accomplishment, but one, if ever made, only to grow out of circumstances which might be made normal to its accomplishment, they, doubtless, were considered of but little value, and, therefore, excited no attention. It is, however, gratifying to find that the very mode I suggested as being the only one which would bring the railroad at length, if it was to come at all, has, for about two years back, been followed by the Government; that is, by opening the several routes as military, post, and emigration roads, and thus making the circumstances normal to a proper knowledge of the routes, and of the capability of the country in relation to them. The Fort Smith and Zuni route has, since my exploration and reports, been surveyed by Captain Whipple, who extended it all the way to California, and its extension is now being worked by Mr. E. F. Beale, for a wagon-road, under the direction of the Government.

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* See vol. ii, Pacific Railroad Reports.

Since my exploration of the route referred to, in 1850, I was over the Santa Fé and Fort Leavenworth route on my return to the States. From May, 1851, to June, 1856, for five years, I was in charge of the General Government roads in the Territory of Minnesota, one of which extended from Saint Paul to Pembina, another from Point Douglass to Lake Superior, another from Mendota to the mouth of the Big Sioux River, and several other roads, all of which, of course, gave me an opportunity of knowing something of the country and climate in that quarter. Since then, during the past year, you are aware of my journeyings to Utah, by Fort Kearney and the North Platte, and of my reconnaissance east and west of Camp Floyd. I mention all this to show my experience in the matters of which I am about to treat, so that my discussion of the subject may be regarded for what it is worth. The mail leaves to-morrow morning, and I am, therefore, obliged to write rapidly and not as fully as I could wish, though my convictions are none the less decided, on account of long consideration of the several routes.

DISCUSSION OF THE SUBJECT.

The public mind has, for a number of years past, ever since the great exodus to California, growing out of the discovery of large deposits of gold in that region, been greatly exercised in relation to the importance and speedy completion of one or more railroads connecting the Atlantic with the Pacific Ocean, across the continent of North

America, and through our national domain. The change created in the minds of men with regard to the real situation of California, in respect to its remote distance from the Atlantic States, by the establishment of a line of steamers on either ocean to the Isthmus of Panama, which would waft the emigrant to the golden port of the Pacific coast, the bay of San Francisco, in one-eighth of the time it was wont to take around Cape Horn; quickly restore him to his friends to tell them what he had seen; and speedily transmit the mails by which the news was kept constantly recurring and fresh, all of which was read by the public with the greatest avidity, have conspired to bring mentally the Pacific coast and its adjoining region very near to us, when, really, in a physical point of view, it is just as far distant as ever.

The consequence has been that what before was believed to be perfectly chimerical, the construction of a railroad across the continent, is now regarded as a thing certain; and not only so, but that it will be accomplished in a few years; people do not say how many, but I suppose they vaguely mean from three to five. Such were the ideas which prevailed ten years ago, and yet not the first certain step has been taken in the consummation of the project. Not a foot of railroad has been laid which may fairly be called a part of the great national railroad, and which has been undertaken with any decided determination to push the road across the continent.

This long lapse of time between the conception of a project of vast importance and the commencement of the undertaking is, however, only the fruit of causes which have been existing all along, and which were first pointed out by the writer, as before stated, in his reports of the Fort Smith route in 1849. Nature remains the same now upon this vast theater between the Mississippi on the east and the Pacific on the west it ever did. The long dreary waste of deserts still are experienced by the toiling, weary emigrant as long and dreary as ever, and the Rocky and other mountains still rear their majestic peaks and ridges, and boldly challenge the strength, energy, and perseverance of the way-worn traveler.

The truth is, facts are stubborn things, and he, be he engineer, statesman, or philosopher, who ignores them, will at length find that he has been following but a vain conceit, which will eventually land him, where an attainable prescience might have forewarned him, into a condition of vain inanity, or, it may be worse, of utter ruin.

We have been led into these reflections by the history of the railroad question, which only within the past two or three years has been approximating toward a solution. In our judgment, facts have been ignored, and desires and vain expectations have been entertained by politicians, and I may say the people generally, which have eventuated in results that might from the first have been anticipated, under reports which it appears to me (in all humility I say it) ought to have dwelt more upon the difficulties of the project, and of the mode in which they are to be determined and met, than upon fanning the public mind with the hot haste which thus far has resulted only in finding, at a late date, from actual observation and experience, that the mode of building the road is, first, to prepare the way by common roads, and opening them to settlement and cultivation, and that then the railroad will normally come, if it comes at all.

Now, all this misapprehension of the failure in regard to the completion of the railroad, as we think, has been owing to two causes, both of which, singly and together, have been operating to produce it. One is the perfect ignorance of the people in respect to the character of the country through which the railroad or railroads are to be built, and, therefore, their inability to realize the true state of the case. The other is the seemingly studious way in which the stubborn facts of the project and unpalatable truths have been kept in the background. I say seemingly studious, for so at first glance it might appear, though I think it has arisen from a habit of mind to dwell, in descriptions of country, upon that which is pleasing, and caring but little to dwell upon that which, though a truth of the greatest importance in the premises, is forbidding; I refer to the almost utter barrenness which characterizes, as a whole, the expanse of country for hundreds, I may almost say thousands, of miles along the several routes. Now, when I speak of the ignorance of the people in respect to the character of the country, I do not speak of it in the way of reproach. Far from it, but only as a fact which they cannot help, and which is common to the most intelligent, and all because, having seen nothing of the same kind in their own experience, they cannot, even by any description which others may give, come up, in their own conceptions, to the utter barrenness and worthlessness, speaking as a whole, which this country throughout nearly its whole extent presents.

For example, the fact may be told a hundred times that the great area of the country, from about two hundred miles west of the States of Arkansas and Missouri, nearly the whole way to the Pacific, is one unmitigated desert (including within this also barren mountains), which a person who has seen it would scarcely take as a gift; and yet, notwithstanding all this, annually you will see bills brought forward in Congress in which the land along the route figures as a very important element in the ways and means to construct the road. Should Congress send out a committee to spy out the utter poverty of the land, as it really exists, it is possible it may be brought to a standpoint from which members will see the fact as it is, and the difficulties on this account, and others may then loom up sufficiently to assure them that the construction of this road will require something more to accomplish it than the legislation which has attended the construction of roads in our densely populated and fertile States, where all is normal to immediate and certain results.

But should not one or more railroads be built across our country? Should not our Pacific possessions and population be brought into closer relation by the quick response of sympathy, social, commercial, and military, which this mode of transit would engender? Should not the trade of the great nations of China and Japan, which by treaty has lately been opened to us, be made available to us as a people and a nation, by the establishment of a hard-iron railway, which, by its slight friction and the steam-car, would rapidly possess us of the rich products of those countries? Does not the quick concentration of troops, necessary in time of danger from threatened invasion, as well as the close bond which should ever subsist between the remotest and all portions of our confederacy, make such a project a *sine qua non* of safety from our enemies from without, and of amity and harmony within?

To all this we most indubitably reply *yes*. But how shall we go to work to build these roads, and what routes shall we take? Shall we have but one road, and that through Northern Texas and Mexico; or shall we take the middle route, through Utah; or would it be best to take the route through Minnesota and the Territories of Nebraska and Washington surveyed by Governor Stevens? Or shall we have two or all the roads?

These have been puzzling questions, as their yet unsettled state shows; but still it seems to us that a solution of them is attainable. The great error, as we think, in the whole of this project has been in the supposition that the road could be built at once, and that all Congress had to do was to will it by legislation. But every project has its normal condition in respect to its accomplishment, out of which naturally and easily is derived the end in view. What, then, is the normal condition which is necessary to the success of so gigantic a railroad scheme? I assert that this condition is in the establishment of the circumstances which will give success to the project. And what are these? Simply those which I have adverted to before, the opening and making practicable by the Government of common wagon-roads along the several proposed lines of railroad-routes, and thus making them military, emigration, and postal routes, by means of which the country will, in eligible locations, be populated; its resources, such as they are, developed; and a knowledge of what really can be done obtained. And I go farther. Not only should these routes be thus established, but Congress, in my judgment, should observe a liberal policy toward the attainment of so important a national good. A comparatively small outlay in this direction will save millions, which may be sunk by the premature commencement of a railroad which might have to be suspended or indefinitely postponed on account of insufficient concurrent means.

Are these circumstances yet normal, on either of the routes, to the successful prosecution and completion of a Pacific railroad?

In respect to the southern route, the policy which is now being observed by the Government, of establishing a military, postal, and emigration road in this direction, must in a few years present a status or condition which will enable the Government and the people to see what really can be done in building a great national road in this quarter.

In regard to the middle or Utah route, the Government, as we think, has wisely made this a military and postal route; and as it has for years been a great highway, it will not be long before the exact status of this road will be known, if it is not already known, in reference to its capabilities and resources as a platform for the proposed railroad.

As it respects the northern or Minnesota route, the Government ought, in the opinion of the writer, also to open and establish a military, postal, and emigrant wagon-road in this direction. This step would not be more productive of advantage to our northwest Pacific Territories of Washington and Oregon than it would be the means of developing the country all along the route, and making the circumstances normal to the expression of its exact condition in respect to the building of a railroad.

As to the question where it is probable the national railroad or railroads will be located, we think it a foregone conclusion that the southern, through New Mexico or Arizona, will be the *locale* of one. We are of this opinion, first, because the grades as determined by the Government explorers are lighter on this route than on either of the others; second, because, if we have a railroad at all, we ought to have one which would be available without intermission the whole year around; and, in order to this, it should be beyond the contingency of obstructions from snow, which could not be the case with the others higher north.

In regard to the route proposed by Senator Benton, and to which Colonel Frémont was most partial, that in the region of the 38th parallel, the surveys by Captains Gunnison and Beckwith show that, from the high grades it would be necessary to overcome, it is entirely impracticable.

That proposed by Captains Stansbury and Beckwith, through Bridger's Pass and by way of Timpanogos, is doubtless far better, in point of grade and practicability, than the one just referred to; but still we think that its cost will never justify its construction, and, if made, that its obstructions by the snows of winter through the high mountain-passes would ever make it an uncertain route.

The route through Minnesota, Nebraska, and Washington Territory, in the region of the 48th parallel of latitude, it might be supposed, from its being still higher north, was out of the question. The facts, however, do not justify such a conclusion. The country, as high as our most northern boundary, and for a number of degrees above it, in British America, has been tried agriculturally, and it is well known that it produces the cereals and all garden vegetables, and some of the succulent fruits in the greatest perfection. The good land, as also the timber regions, approximate on this route nearer than on either of the others. From a map in my possession, copied from one drawn by a Jesuit missionary, the Rev. Peter John De Smet, who kindly loaned it to me for the purpose, I translate the following remark, which applies to the country all along the east foot of the Rocky Mountains, from about the river Maria, a tributary of the Missouri, in latitude 48°.50, to the Saskatchewan River, or latitude 53°—that is, for an extent, following the oblique trend of the mountain range, of for more than 400 miles. His notation is, "All the region which lies adjacent to the Rocky Mountains is agreeably diversified with fertile plains and beautiful forests; lakes and hills give variety to the landscape between the heads and forks of innumerable streams, and wild animals of every kind abound."

Besides, the reverend gentleman, in pointing out to me this region of country, spoke of it in the most glowing terms. He has been for 12 years a missionary among the Indians of Oregon, Nebraska, and farther north in British America, and is probably as well acquainted with all this region as any man living. He acquired the ability of taking notes of reconnaissance in one of the expeditions of Monsieur Nicollet, and has ever since been in the habit of doing so, and plotting his routes. In this connection, I refer you to an extract, herewith, from quite a sensibly-written article entitled "Fraser River," which I find in the last October number of the *Knickerbocker*. The remarks of the writer in reference to the track northwestward which is to mark the direction of empire, and where villages, towns, and cities are destined to spring up, I think, are quite just.*

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* From an article entitled "Fraser River," in the *Knickerbocker* of October, 1858.

Here is the great fact of the northwestern area of this continent. An area not inferior in size to the whole United States east of the Mississippi, which is perfectly adapted to the fullest occupation by cultivated nations, yet is

This northern route, then, passes over a country which is cultivable for a very considerable portion of its extent. Wood and water are doubtless more abundant upon it than upon any of the other routes; and the grades, according to Governor Stevens, are not impracticable for a railroad. The snows, too, are not so heavy as

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almost wholly unoccupied, lies west of the 98th meridian and above the 43d parallel; that is, north of the latitude of Milwaukee, and west of the longitude of Red River, Fort Kearney, and Corpus Christi. Or, to state the fact in another way, east of the Rocky Mountains, and west of the 98th meridian, and between the 40th and 60th parallels, there is a productive, cultivable area of 500,000 square miles. West of the Rocky Mountains, and between the same parallels, there is an area of 300,000 square miles.

It is a great mistake to suppose that the temperature of the Atlantic coast is carried straight across the continent to the Pacific. The isothermals deflect greatly to the north, and the temperatures of the Northern Pacific areas are paralleled in the high latitudes of Western and Central Europe. The latitudes which inclose the plateaus of the Missouri and the Saskatchewan, in Europe inclose the rich central plains of the continent. The great grain-growing districts of Russia lie between the 45th and 60th parallels, that is, north of the latitude of Saint Paul, Minn., or Eastport, Me. Indeed, the temperature in some instances is higher for the same latitudes here than in Central Europe. The isothermal of 70° for the summer, which in our plateau ranges from along latitude 50° to 52°, in Europe skirts through Vienna and Odessa in about parallel 46°. The isothermal of 50° for the year runs along the coast of British Columbia, and does not go far from New York, London, and Sebastopol. Furthermore, dry areas are not found above 47°, and there are no barren tracts of consequence north of the Bad Islands and the coteaux of the Missouri. The land grows grain finely and is well wooded. All the grains of the temperate districts are here produced abundantly, and Indian corn may be grown as high as the Saskatchewan.

The buffalo winter as safely on the Upper Athabasca as in the latitude of Saint Paul, and the spring opens at nearly the same time along the immense line of plains from Saint Paul to Mackenzie's River. To these facts, for which there is the authority of Blodgett's Treatise on the Climatology of the United States, may be added this, that to the region bordering the Northern Pacific, the finest maritime positions belong, throughout its entire extent, and no part of the West of Europe exceeds it in the advantages of equable climate, fertile soil, and commercial accessibility of coast. We have the same excellent authority for the statement that in every condition forming the basis of national wealth, the continental mass lying westward and northwestward from Lake Superior is far more valuable than the interior in lower latitudes, of which Salt Lake and Upper New Mexico are the prominent known districts. In short, its commercial and industrial capacity is gigantic. Its occupation was coeval with the Spanish occupation of New Mexico and California. The Hudson's Bay Company has preserved it an utter wilderness for many long years. The Fraser River discoveries and emigration are facts which the company cannot crush. Itself must go the wall, and now the population of the great northwestern areas begins.

Another effect of the Fraser River discoveries is their determination of the route for the great Pacific Railroad. In view of the facts which we have just stated, it becomes clear that if the population of the United States were evenly distributed from the Gulf of Mexico to the great lakes, the existence of these northwestern areas would draw the lines of travel to the Pacific sensibly to the north. But the Northern States are by far the most densely populated. The center of population is west of Pittsburgh; of productive power, to the east and north of that city. The movement of these centers is slowly to the west and to the north of west. At our present rate of increase, in less than fifty years they will be near Chicago. Their line of direction indicates the track of westward empire, and the general route along which villages, towns, and cities will arise, and therefore the first railroad be built to the Pacific coast.

Beyond and above all possible interferences and obstructions of political or sectional zeal, beyond human control, these great movements of nations and peoples go on without their foresight, and without the knowledge of the earlier generations; yet, working out in beautiful order, and as if with universal consent, and the conspiracy of all the secret forces of nature, their grand and best results.

If we recall, in this connection, the precise position of the *mauvaises terres*, and the rainless, sandy, and uninhabitable areas of the continent, the nature and location of the mountain chains, exclusive of the Rocky Mountain range, extending from latitude 47° to 33°, headed at the south by the Gila River, on whose southern side are the arid, uncultivable tracts of Sonora, and headed at the north by the Missouri River, on whose northern side lie these vast, cultivable and inhabitable areas; if we recall the remarkable deflection to the westward of the Rocky Mountain range in this latitude; if we recall, also, the course of that gigantic stream, which is far greater than the river to which by a mistaken nomenclature, it is made tributary, a stream extending to the very base of the Rocky Mountains, in the region where they are lowest and transits easiest, navigable for steamers for two thousand four hundred and fifty miles from its mouth, and for smaller vessels almost within sound of the Great Falls; if we recall, also, the remarkable deflection to the north of the isothermal lines from the west of Lake Superior, already mentioned, and the position of Columbia River, and remember withal that the first and the great routes of travel are always where nature has scooped out valleys for the passage of great rivers; if we combine all these conceptions with the one first advanced, of the direction of the movement of the centers of population and industrial activity, there remains no room to doubt that even without naming the northwestern areas, that along the valley of the Missouri, over the Rocky Mountains, in the low passes of latitude 47°, and thence by the Columbia and its tributaries to the Pacific, or through the passes of the Cascade range to the splendid harbors of Puget Sound, lies the great route to the Pacific, the belt on which towns and villages will first arise, the strongest link in the union of the Atlantic and Pacific States. The Fraser River discoveries have hastened the result; they have not diverted it.

in more southern latitudes. In addition, the navigability of the Missouri high up in this region will facilitate the construction of the road. These facts certainly are important, and not only show that the country is worthy of the immediate attention of the Government in respect to its development, by the establishment of a military post and emigration route all the way to Washington Territory; but they also point to the day when a railroad will be normal to the then existing state of things, and follow as a natural consequence.

The question of making a railroad across the continent is one, however, of no ordinary magnitude, and it is nothing wonderful that every administration has been backward in taking hold of it. When we reflect that the road will probably be worked at but few points at one time—be probably pushed out from either extreme; that it will not have the dense population of the States immediately about it, whence the necessary labor is to be drawn; that there will be no thousand avenues of commerce by which all the necessary materials and supplies can be conveyed; that there will be but few centers of population whence aid or facilities of any kind can be had; that the road must necessarily pass through a desert where but little or no suitable timber can be found for the superstructure, it may be readily seen why there is such a reluctance in taking hold of so gigantic a scheme. Besides, if it is once taken up, it should be prosecuted to an immediate completion; for, on the supposition that the route is 2,000 miles long (and none of them would be much short of it), if 100 miles of road should be made in a year, it would take 20 years to build it; and during this period a portion of it, if wooden ties are used, will have rotted out twice. If 200 miles are made, which, considering the difficulties in the way, would be a great deal of work, it would take 10 years to build it, and then a portion of it will have rotted out once. These are ugly features, but it is better to look at them in advance than to be startled by them when loss and ruin shall have ensued. The matter would not be so bad if the road could be made profitable as it advances; but this would probably hold true of but the northern one, for the reason that the region through which the others would be laid can never, on account of its sterility, support a dense population, and hence there could arise but little need of commercial facilities until the road should have been made entirely through.

Again, the length of the road would be such, so far as bulky articles are concerned, as to make it ruinous to have them conveyed in this way. The merchant-ships, though slower, would doubtless still monopolize all this heavy, bulky trade. The road would then chiefly have to depend for its support upon passengers, the freight of small packages, and the aid the Government might give it by its transmission of the mails and the transportation of troops and munitions of war. But still its great service in binding the extremes of our confederacy together, and its important use in a military point of view, would doubtless induce the Government to contribute its utmost toward keeping it in operation.

To my mind, scarcely second to the project of a great national railroad across our continent, looms up the important one of a ship-canal through Central America. This, it strikes me, is the great political, commercial, financial, physico-scientific, moral, and religious problem of the age; and, if it could be accomplished, would do more to civilize and Christianize mankind than any and all other projects taken together. It is a gratification to see, by the Secretary of the Navy's report, that the two officers who were sent out by the Government to survey the Atrato River route do not agree in their conclusion as to its practicability. I had been led to believe, from what I had read in the public prints, that the route had been condemned; but this statement of the honorable Secretary leaves a gleam of hope that the great work may yet be accomplished. This Atrato route the late Dr. Foote, when minister to Bogota, brought, as he told me, to the attention of Mr. Webster, then Secretary of State under Mr. Fillmore, and he felt sure, from the information he had obtained upon the subject, that it was well worthy of examination.

This great work deserves the attention of every nation in the world, and, if it cannot be accomplished in any other mode, should be effected by them in conjunction, and thrown open to ships of every clime. A congress of nations for the purpose should, it strikes me, if necessary, be called together, and some feasible plan adopted. But I have carried this letter to an unconscionable length, and will, therefore, not tire your patience any longer by its continuance.

I am, very respectfully, your obedient servant,

J. H. Simpson,
Captain Corps Topographical Engineers.

James H. Sanford, Esq.,
Buffalo, N. Y.

APPENDIX I.

REPORT
ON THE
GEOLOGY OF THE COUNTRY
BETWEEN
FORT LEAVENWORTH, K. T., AND THE SIERRA NEVADA
NEAR CARSON VALLEY.

BY

HENRY ENGELMANN,
GEOLOGIST OF THE EXPEDITION.

La Salle, Ill., *December* 29, 1875.

Dear Sir: I have to-day forwarded to you, by express, the manuscript of my geological report of your exploration of 1858–'59 (two copies), which you had the kindness to send me for revision. I have made no essential changes or corrections, but have only struck out some passages which, at this date, appeared to me irrelevant or out of place. I was inclined to shorten the report materially, but this would have necessitated a rewriting of a large portion of it.

In returning to you the report I have to say that I was much pleased to find that I had really no cause to make any essential corrections. When this exploration was made, the country over which it extended was virtually for the most part a wilderness, partly then trodden for the first time by the foot of the white man. Its mineral wealth had then not been discovered. Now the whole of it is spanned by the iron rail, with many branch roads leading into its distant valleys. It is teeming all over with human industry. The open country has become the domain of the farmer and stock-raiser; numerous coal-mines have been opened at distant points; every mountain and gulch has been explored by the omnipresent miner; steam batteries thunder in its most distant mountain recesses, crushing the ores of the precious metals; and cities have sprung into life and prosperity where then only the squalid Digger Indian hunted the ground-rat. Then the geological exploration was confined to a naturally incomplete reconnaissance within reach of a military escort. Since then, splendidly-equipped geological exploring parties have spent years in closely examining the whole district. Numerous scientists have spent the summer seasons rusticating in the mountains, while mining engineers have professionally traversed it in every direction.

Under these circumstances, the interest with which some parts of this report would have been received at the time when it was written, does, of course, not any longer attach to it. It is, in fact, superseded; but its perusal will show that while it is necessarily fragmentary and incomplete, it represents the general outlines of the geological structure of the country pretty correctly, and contains many diligently-compiled details. In consequence of the non-publication of the report, the credit due to it has, in various instances, been claimed by later observers. In revising the report for publication, I have therefore abstained from making any essential alterations, preferring to let it stand on its merits such as it was originally written, merely eliminating some too lengthy remarks.

I am, dear sir, your obedient servant,

Henry Engelmann,
Mining Engineer.

General J. H. Simpson,
Colonel of Engineers, U. S. A., Saint Louis, Mo.

APPENDIX I.

REPORT ON THE GEOLOGY OF THE COUNTRY BETWEEN FORT LEAVENWORTH, KANSAS, AND THE SIERRA NEVADA, NEAR CARSON VALLEY.

[BY HENRY ENGELMANN, GEOLOGIST OF THE EXPEDITION.]

INTRODUCTION.

WASHINGTON, D. C., *July* 19, 1860.

SIR: I herewith submit to you my report on the geology of the country traversed by the expedition under your command in 1858 and 1859, from Fort Leavenworth, Kansas, to the Sierra Nevada, near Carson Valley. Only little has been known, heretofore, of the geology of this whole country, except of its eastern portion, and even there important questions remain unsettled, while the western portion has been altogether a *terra incognita.* By your expedition, therefore, important additions have been made to our knowledge of the geological structure of the central portions of the continent.

Some additional observations have been made in regard to the Upper Carboniferous and more recent formations of Northeastern Kansas. In the remarkable bluff formations of the North Fork of Platte River, below Fort Laramie, mammalian and chelonian remains have been discovered, which indicate their analogy with the interesting deposits of the Bad Lands of White River, famous for the abundance of their terrestrial pre-adamitic fauna; and the general character and succession of the Tertiary strata have been investigated, from the most recent to the oldest, along Platte River, and farther on across the South Pass to the Wahsatch Mountains. The existence of Jurassic strata in the territory of the United States, which had been very problematical till within a short time, when they were first recognized in the Black Hills, by Mr. Meek and Dr. Hayden, on Lieutenant Warren's expedition, has been fully established, and they have been recognized at various points in the Rocky Mountains near North Platte River, and on the eastern slope of the Wahsatch range. The Triassic and Cretaceous Epochs have also been found represented. In the Green River Valley a Tertiary fresh-water formation has been discovered, and in the Wahsatch Mountains an estuary, possibly Eocene Tertiary, deposit. Sandstone and coal formations of apparently Cretaceous age have been observed, considerably developed in that range.

The extensive distribution of coal, partly of very superior quality, from the eastern part of the Rocky Mountains to the Salt Lake country, has been more fully demonstrated, and is of paramount practical importance, bearing upon the question of the best location of a railroad to the Pacific coast.

The physical geography and geological structure of Central and Western Utah, of the so-called Great Basin, has been investigated, and the prevalance of igneous rocks there has been shown, part of which are of great age, while most of them appear to be of comparatively recent origin. In its eastern portion Paleozoic formations have besides been found in most of the mountain ranges; the Upper Carboniferous strata, which had before been recognized at a few points, have been traced as far as 200 miles west of Salt Lake; and decidedly Lower Carboniferous and Devonian strata have been recognized there for the first time in the far-west, the latter, 1,200 miles, in a straight line, from the nearest point where they have before been found *in situ*, as far as is known, in the territory of the United States. The existence of the Silurian formation in the same district has been rendered probable. In the western part of the Basin only a few highly-altered stratified rocks were noticed, together with the eruptive masses.

I have divided the whole distance in five sections, according to their distinct geological and physical characters and configuration. They are:

Section I. The district of Eastern Kansas and Southeastern Nebraska, extending westward from the Missouri River, as far as the older formations reach, including the Cretaceous.

Section II. The plains, comprising the country from the western limits of section I to the foot of the Rocky Mountains.

Section III. The district of the Rocky Mountains, including the area between Fort Laramie and the South Pass, or, in other words, from the eastern foot of the Rocky Mountains to the divide between the waters of the Atlantic and Pacific Oceans.

Section IV. The Green River Basin, extending thence to the axis of the Wahsatch Mountains, to the eastern rim of the Great Basin.

Section. V. The district of Central and Western Utah, the so-called Great Basin, between the Wahsatch Mountains and the Sierra Nevada.

In each of these sections I have given a synopsis of the surface configuration and general character of the district, then a description of the geological formations therein, and finally, some condensed remarks upon the economical geology. Only in section V, I have changed this order somewhat, on account of the greater variety of questions which had to be discussed there.

As the organic remains of the collection have been examined by my friend, Mr Meek, who has, in a separate report, given descriptions of them, and stated the conclusions at which he has arrived by their investigation, I have generally avoided entering into paleontological discussions. By the shortness of the time allowed for the completion of this report, I have been prevented from making some chemical analyses, especially of coal and minerals, which would have given additional practical and scientific interest to the report; but by tests before the blow-pipe I have determined the qualitative composition of some salts and minerals, mostly during our confinement in the winter-quarters at Camp Floyd, which will be found in their respective places. The collections, upon which our main results are based, have been deposited at the Smithsonian Institution, in the museum of which they have been arranged for exhibition, while some duplicates have been sent to the Military Academy at West Point.

A geological map and profile are in the course of construction, which will illustrate

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stratified rocks which have been more or less altered or metamorphosed. In some localities they still exhibit perfectly preserved fossils, in others merely faint traces of organic remains, and in still others their lithological characters show a perfect transition into those of truly metamorphic rocks. Even those which are less altered cannot be sufficiently distinguished from each other, by their lithological characters alone. I therefore have introduced one color for all the rocks which are evidently of Paleozoic age, but which cannot be, with certainty, assigned to any one of the different Paleozoic formations. If, in a range, fossils have been found characteristic of a certain one of these older formations, I have colored the whole range accordingly. In many instances I was doubtful whether I should color rocks as Paleozoic or metamorphic, the transition being so gradual. From the Wahsatch Mountains westward I have marked several deposits with the color adopted for the Post-Pliocene formations, applying the term Post-Pliocene in its widest meaning, that it designates all deposits formed from the close of the Pliocene period to the present day. In that particular district I had thus marked the more solid or regularly stratified deposits, which have been formed posterior to the Tertiary formation, but which I wanted to distinguish from the loose alluvial deposits which have, on the profile, received a distinct color.

I cannot conclude these remarks without thankfully acknowledging the active interest with which Brig. Gen. A. S. Johnston, commanding Department of Utah, did all in his power to further these surveys. For some valuable specimens in the collection, I am also under obligations to Colonel Crosman of the Quartermaster's Department, and to the Assistant Surgeons Dr. K. Ryland and Dr. Charles Brewer, the latter of whom communicated some interesting information about the country south of Utah Lake. Last, but not least, I express my gratitude to my commander for his constant desire to facilitate the acquirement of all possible information, and to promote the interests of the survey in general, as well as for the numerous acts of personal kindness by which I have been favored.

I am, sir, most respectfully, your obedient servant,

HENRY ENGELMANN,
Geologist and Mining Engineer.

Capt. J. H. SIMPSON,
Topographical Engineers, U. S. A., in charge of Explorations.

SECTION I.

NORTHEASTERN KANSAS AND SOUTHEASTERN NEBRASKA.

GENERAL CONFIGURATION AND LIMITS—GEOLOGICAL FORMATIONS—CARBONIFEROUS AND PERMIAN FORMATIONS—CRETACEOUS AND OLDER FORMATIONS—ECONOMICAL GEOLOGY—SURFACE DEPOSITS—WATER—SOIL—TIMBER—BUILDING MATERIAL—COAL—MINERALS.

This district comprises the country along the most eastern portion of our route, extending westward, from the Missouri River near Leavenworth, as far as the older formations, including the Cretaceous, continue near the surface, and exercise a marked influence upon the configuration and general character of the country. As the upper and most western division of these rocks is horizontally stratified, and composed of mostly soft and readily decomposing strata, the evidences of its presence are easily obliterated by the increasing thickness of the more recent Tertiary and Post-Tertiary deposits, and, therefore, the limits of this section are not very distinctly marked. On our route, which is the main route from Leavenworth to Fort Kearney, on the Platte River, and mostly keeps the divide between the Missouri and Kansas Rivers, we cross these limits on the Little Blue, while, farther south, along the principal streams, they stretch much farther westward, in consequence of the deeper erosion of the valleys, and the trend and dip of the strata.

The general character of the country is that of beautifully rolling prairies, such as we find them in Northern Missouri, in Iowa, &c., with seams of timber along the water-courses. It is more broken only in the vicinity of the principal streams, especially the Missouri and Kansas Rivers, and as far as the oldest formations extend, which contain numerous hard strata, forming prominent bluffs and rocky precipices. But at a greater distance from the main arteries of drainage, and where the substrata are softer, the valleys become open and flat, and the country more and more assumes the character of the next section, the plains.

The rocks of this district belong to the Upper Carboniferous and the Cretaceous formations, at some points with a considerable intermediate series of, possibly, Permian, and, perhaps, also of Jurassic and Triassic rocks. The latter seem to be wanting in the northern part of the section, and only to come in gradually toward the south, thus indicating a repetition of the rule of the gradual increase of thickness of the strata, and of the intercalation of new formations toward the south, which has been observed by Prof. I. Hall, in regard to the Lower Carboniferous formations on the Mississippi River. (See Report on the Geology of Iowa, vol. i.) It does not appear to be the consequence of powerful denudations, but rather of a gradual change of level of the surface of the land during the extended period to which these various strata owe their origin. They are, therefore, not exactly conformable, although they have nowhere been observed to be considerably tilted and disturbed.

The geology of this district has lately been investigated by Mr. F. Hawn, in connection with Prof. G. C. Swallow and Dr. B. F. Shumard, and by Mr. F. B. Meek and Dr. F. V. Hayden. To the labors of these gentlemen we are indebted for many highly interesting additions to our knowledge of its geology. I will only mention the discovery of a formation of Permian affinity before unknown on this continent. It was expected that our explorations might throw additional light on some points which cannot yet be considered as fully established, and in regard to which the different investigators have arrived at varying conclusions, but unluckily our line of travel has passed too far north, where only few of the intermediate strata are developed, and where the outcrops are much scattered and covered up by detritus and Post-Tertiary deposits. I can, therefore, not attempt generalizations, and will confine myself to give an account of the observations which were made while, traveling westward, we came successively from the older to the more recent strata.

THE CARBONIFEROUS AND PERMIAN FORMATIONS.

We only find the upper strata of the Carboniferous system, forming the continuation of the Upper Carboniferous series, as it is developed along the Missouri River, and has been fully described by Professor Swallow, in the report upon the geological survey of the State of Missouri. At Leavenworth, nearly the whole third or upper series of the Coal-Measures of the Missouri report is exposed; the stratum No. 1 crowning the hill back of the fort, while at the lower end of Leavenworth City the lowest beds, Nos. 20 to 25 of the series, crop out, and only Nos. 26 and 27 are under the water-level. In the Missouri report the following section is given:

1. 10 feet hard, bluish-gray, ferruginous, subcrystalline, siliceous limestone, interstratified with brown clay. At Fort Leavenworth it is a compact, subcrystalline, grayish and light-buff colored limestone, wholly made up of fossils, numerous *Brachiopoda*, *Fusulina cylindrica*, joints of *Crinoidea*, &c.
2 and 3. 6 feet shales.
4. 3 feet coarse, grayish-white, crystalline limestone.
5. 15 feet bituminous shale.
6. 20 feet blue, buff, and gray siliceous, cherty limestone, interstratified with some shale. (It forms a terrace at the hill back of the fort).
7. 12 feet shale.
8. 7 feet red, yellowish, and gray friable sandstones.
9. 4 feet dark, argillaceous limestone.
10 to 19. 139 feet argillaceous shales, alternating with sandstones and limestones.
20. 8 feet argillaceous, shaly limestone.
21. 3 feet thin-bedded, ripple-marked sandstone.
22. 4 feet bituminous blue shale.
23. 20 feet hard, fine-grained, bluish-gray and buff ferruginous limestone.
24. 5 feet bituminous shale.
25. 2 feet hard, compact, dark-blue limestone.

These rocks continue up the Missouri River until they gradually dip under the water-level, with only a few feet, or none at all, of higher Carboniferous strata intervening between them and the succeeding and overlying ferruginous sandstone of Cretaceous age. Dr. Hayden saw the last of them, on the Missouri, some 50 miles above the mouth of Platte River. At Florence, about 7 miles above Omaha City, they form the bed of the river. On the Platte, they dip under ground near the mouth of Elkhorn River. Farther south, however, a considerable thickness of strata is observed above this series, which, by their organic remains, are characterized as members of the same Upper Carboniferous formation. In their upper portions, gradually Permian types of fossils appear, thus forming a transition between the strata of the Carboniferous and Permian periods, apparently filling the break which exists between the two in the eastern hemisphere. I have myself observed these strata, which we may provisionally call Permo-Carboniferous, on the Republican River, extending as far as 32 miles above its mouth. (See Explorations of Lieut. F. T. Bryan, T. E., 1856. Report of Secretary of War, 1857). The highest strata of this series, in that locality, appear to be identical with No. 11 of Messrs. Meek and Hayden's Kansas section. (Proceedings of the Academy of Natural Sciences of Philadelphia, January, 1859). My collection then only contained Carboniferous types of fossils, which were determined by Dr. B. F. Shumard. Still farther south these upper formations seem to be considerably more developed.

Beyond Fort Leavenworth, on the road to Fort Kearney, the compact limestones of the upper members of the Missouri section form prominent belts of *débris* near the top of the hills, the sides of which, corresponding to a series of argillaceous shales, soft sandstones, and shaly limestones, are mostly covered with detritus. Farther on we frequently do not find the smallest outcrop for many miles.

The compact, siliceous gray and buff limestones were thus noticed near Salt Creek, and again at our first camp, some 8 miles from the fort. There they contain various *Productus*, *Spirifer*, *Chonetes;* numerous *Fusulina cylindrica;* fragments of *Crinoidea*, and various *Bryozoa*. Some miles farther on, near the head of a drain, the same Fusulina limestone is exposed, and below it some argillaceous shales, and a calcareous, micaceous sandstone, with impressions of long, narrow leaves, and a few particles of coal. Near Mount Pleasant, I again found such limestone, while on the branches of Independence Creek, only shales were noticed. Some limestones on the East Fork of Grasshopper Creek still present the same lithological character, but contain numerous *Fusulina cylindrica* of the ventricose variety, and may, perhaps, occupy a higher geological horizon than the Leavenworth rocks. On Clear Creek, 43 miles from the fort, they again appear to be exactly like No. 1.

At the next branch, 2 miles farther on, a similar stratum crops out, some 40 feet above the water, while lower down some layers of yellowish and gray argillaceous limestone are exposed, quite fetid from the large number of organic remains, among which I noticed several *Productus*, *Orthis*, *Allorisma*, *Myalina*, *Bellerophon*, stems of *Crinoidea*, &c., all decidedly Carboniferous forms.

Only on the top of the hill east of Walnut Creek, about 50 miles from the fort, I found the first rock which presents an appearance decidedly different from any I had seen farther east. It is a yellowish limestone, altogether composed of small bivalves of the genera *Pecten*, *Myalina*, *Pleurophorus* (?), &c. About 40 feet lower down, 10 feet of gray and yellowish friable, micaceous sandstone are exposed, above which I found fragments of compact gray limestone, with numerous remains of *Brachiopoda*. Similar limestones continue up Walnut Creek, north of the road.

Although the outcrops along our line of travel were too small and too far apart to base a decided opinion upon, I feel, nevertheless, inclined to consider the stratification of the Coal-Measures not as absolutely regular, with a uniform dip in one direction, but as exhibiting slight undulations, so that we meet with repetitions of the same strata at points where, if the dip was uniform, they would occupy a considerable depth under ground.

I was informed that 6 miles south from Oak Point, on Muddy Creek, a small seam of a good bituminous coal has been found. On the Big Nemaha, at Seneca, 82 miles from Leavenworth, sandstone is exposed in the banks of the creek. On a branch, 2 miles southeast from there, I noticed a seam of good coal, 8 to 10 inches thick. The far-scattered outcrops seem to indicate the following section:

20 feet limestones, compact, siliceous, gray, yellow, or brown, with numerous fossils, joints of *Crinoidea*, *Orthis*, *Chonetes*, *Axinus*, *Posidonia* (?), and *Fusulina cylindrica*, var. *ventricosa.*
20 feet argillaceous shale.
⅓ foot calcareous slate, with pyrites and columns of *Crinoidea.*
⅔ foot coal.
20 feet or more sandstone.
——— shales.

Limestone similar to the above was also observed at Richmont, 2½ miles lower down on the Nemaha, and still farther down, I am informed, coal crops out. If this is the same seam, the undulation of the dip must be considerable.

From the Nemaha to the Blue, outcrops are very scarce. In the drains off the road and on the slopes, occasionally slabs of limestone are found. On the Vermilion, some miles south of the road, a whitish magnesian limestone is quarried, remarkable on account of the large number of small cavities which it presents, all caused by the weathering out of *Fusulina cylindrica.* A stratum very much like it has been observed near the mouth of the Big Blue River, and No. 22 of Messrs. Meek and Hayden's section presents the same character.

About 14 miles east of the Big Blue, on the top of a hill near the upper road, we find 6 feet of a rock resembling closely the building-stone at Fort Riley, quarried there, near the top of the hills, at the junction of the Republican and Smoky Hill Forks. It is a light buff-colored magnesian limestone, finely granular on the fracture, and nearly made up of fossils, of which, however, only few are well preserved. It is easily dressed, and makes a superior building-stone.

White, green, and gray argillaceous shales were noticed in the drains farther on, and we have now fairly entered the limits of the Permo-Carboniferous formation. Near the Big Blue, in consequence of the deeper erosion of the valley, more rocks are exposed, mostly whitish, grayish, or yellowish, impure argillaceous limestones or marls, partly honey-combed, or containing numerous secretions of flint. The harder layers form terraces and belts of *débris* along the slopes. I noticed in these beds various *Productus*, *Pecten*, *Bellerophon*, columns of *Crinoidea*, numerous *Bryozoa*, and spines of *Archæocidaris;* also the flat tooth of a fish of the *Placodean* tribe. The following is a section compiled from measurements at several points, near the crossing of the Blue, at Marysville:

40 feet slope, apparently underlaid with argillaceous shales and marly limestones, of gray and yellowish colors, and with flint, resembling the following strata.
8 feet limestone, compact, light grayish, and yellowish, in places chalky, and full of fossils.
15 feet slope.
10 feet alternations of such limestones and flint in thin, irregular beds.
30 feet bluish-gray argillaceous shale and calcareous marl, or rotten, chalky calcareo-argillaceous slates.
15 feet alternations of white, gray, or yellowish earthy limestones, and flint in thin layers, with only few fossils.
10 feet slates.
Water-level of the Big Blue River.

Cottonwood Creek, 12.5 miles west of the Big Blue, is the last point on the road where strata of this same series crop out. I observed there 21 feet of a yellow limestone, with finely-grained, earthy fracture, containing numerous *Pecten* of different species, and *Bakevellia,* underlaid by 15 feet of greenish, gray, and purple argillaceous shales. Higher up on the hills more argillaceous shales were noticed.

On the ridge, between the Big Blue and Cottonwood Creek, nearer the latter, a change had been observed in the formation. There, in a drain, several strata were exposed of light-yellowish chalky or arenaceous magnesian limestone, partly vesicular, containing *Bellerophon* and a few other fossils, interstratified with variegated argillaceous shales. They are capped by light-colored arenaceous shales, with ferruginous concretions, changing into yellow or brown soft sandstones, with hard, dark-brown, highly ferruginous portions. While the lower strata form the continuation of the series, which is developed on the Big Blue and Cottonwood Creek, the upper strata belong to

THE CRETACEOUS (OR, PERHAPS, JURASSIC OR TRIASSIC) FORMATIONS.

Neither in these nor in similar strata farther west did I observe any fossils, and their exact position can, therefore, not be determined. To judge from their lithological character alone, I should consider them as beds of transition to the ferruginous sandstones of the Cretaceous formation, the No. 1 of Messrs. Meek and Hayden's Kansas section, which I found farther west; but otherwise they resemble much Nos. 2 and 3 of that section, which have been considered by them as probably Triassic or Jurassic, which may, however, turn out to be likewise Lower Cretaceous, corresponding to the Marly Clay group of Dr. B. F. Shumard, which underlies the sandstone No. I in Texas. (Transactions of the Academy of Science of Saint Louis, vol. I, No. 4, 1860). I did not notice any beds of gypsum or lignite, which have been found in similar formations farther south; but it must be borne in mind that, as I have stated above, these strata thin out altogether toward the north, and near our route are already much less developed than farther south, where the other gentlemen have examined them; besides, that such formations are generally much subject to local changes.

Between Cottonwood and Rock Creeks small outcrops of argillaceous and arenaceous shales were observed, and only nearer to Rock Creek, 20 feet of light-brown and purely quartzose sandstone. On Rock Creek the followiug section was obtained:

On top of the hill, about 150 feet above the creek, there is a layer of dark-brown, very hard ferruginous sandstone, partly even-grained and partly of a coarse, uneven grain. Inside most of the pieces are much lighter colored and less cemented, even friable. Then follow—

80 feet of slope, with occasional outcrops of shale and sandstone, some of which is very compact and finely grained.

40 feet of white, purely quartzose sandstone, with an even and rather fine grain, and easily crumbling. It generally does not show any distinct stratification.

The lowest 30 feet are gray and white argillaceous shales, not all well exposed.

There, also, I did not find any organic remains, except indistinct impressions of wood, in the ferruginous sandstone, on top of the hill. I have, however, little doubt that, if not the whole section, then, at least, this upper bed, is Lower Cretaceous, the No. I of the Nebraska section; and the whole may correspond to the Arenaceous group and Marly Clay group of Dr. Shumard. West of Rock Creek the exposures are scarce, the rocks being too friable, and easily disintegrating. Only on the hills, toward Little Sandy Creek, I noticed strata similar to those on Rock Creek—white quartzose sandstone, overlaid by gray and white argillaceous shales, with arenaceous and ferruginous portions and seams—and higher up large flags of dark-brown ferruginous sandstone. A little farther on, the hills which overlook Little Sandy Creek are capped by white limestone, nearly made up of *Inoceramus* (*Inoceramus pseudomytiloides* and *I. aviculoides*), and in which also a *Baculites* was found. They correspond to No. III of the Nebraska Cretaceous section of Messrs. Meek and Hayden, which is so largely developed on the Upper Missouri. Underneath this rock follows a series of argillaceous shales about 40 feet thick, which seems to be an equivalent of No. II of the Nebraska section; and on the creek the ferruginous sandstone is exposed, apparently the No. I of that section.*

The last small outcrops of the Cretaceous limestones and marls were observed on Big Sandy Creek, and near there, on Little Blue River, but they evidently continue near the surface a considerable distance farther up that river, as we may judge from the growth of timber in the creek bottom. While with Lieutenant Bryan, I found these limestones and marls considerably farther west, near the ninety-eighth degree of longitude, only a few miles south of Little Blue River, and on the Republican, from 74 miles above Fort Riley, near longitude 97° 25′, and latitude 39° 38′—where I observed a section quite similar to that on the Little Sandy—extending about 100 miles, to longitude 98° 45′ and latitude 40° 05′. On Solomon's Fork they are found still farther westward.

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* Although I have no paleontological evidence that this sandstone is No. I, still I can entertain no doubt in that respect. It underlies the other Cretaceous strata, and is lithologically the same as the rock which I have found largely developed on the Republican River, where, about 75 miles above Fort Riley, it holds the same relation to the *Inoceramus* beds, the same which Mr. Meek, Dr. Hayden, Dr. Newberry, Mr. Hawn, Mr. Pratten, and others have frequently seen in the same position, as well in Kansas as in Nebraska, and in which, at many of these localities, numerous impressions of dycotyledonous leaves have been discovered.

ECONOMICAL GEOLOGY.

I have stated above that the country along our line of travel is a succession of rolling prairies. The surface-deposits above the regularly stratified rocks of the older formations are generally very heavy, and consist of drift-sand, clay, gravel, and soil; at numerous points bowlders are scattered over the surface, partly of granite, but mostly of a very compact, light-reddish quartzose rock.

Water is mostly obtained at a depth of from 40 to 70 feet, at least in the eastern portion of the district. The following sections of wells were obtained:

1. On the upland, 17 miles from Leavenworth:
    - 2 feet of dark clayey soil, highly productive.
    - 12 feet sand and clay, mixed.
    - 5÷6 feet joint-clay, a shaly clay with numerous fissures, which allow the slow percolation of water.
    - 32 feet yellow and brown drift-sand, mostly of fine grain, with little clay.
    - Stiff clay or shale, impermeable to water, on reaching which water was obtained; total depth, 52 feet.
2. On the upland, 33 miles from Leavenworth, near Lancaster:
    - 3 to 4 feet soil, argillaceous, and slightly arenaceous, highly productive.
    - 36 feet drift-sand of yellowish color, free of clay.
    - Below this water was reached, in a fine sand, before having penetrated the substratum of clay; total depth, 40 feet.
3. Half a mile from the latter locality, in the same ridge:
    - 6 feet soil.
    - 12 feet drift-sand.
    - 25 feet joint-clay.
    - 3 feet gravel, in which water was reached; total depth, 46 feet.
4. On the ridge, 38 miles from Leavenworth:
    - 4 feet soil, dark areno-argillaceous, highly productive.
    - 20 feet yellowish tough clay.
    - 30 feet bluish joint-clay.
    - 6 feet white and yellow quartz sand, in which a large supply of water was obtained; total depth, 66 feet.
5. Near Oak Point, on the upland, about 56 miles from Leavenworth:
    - 4 feet soil like the above.
    - 20 feet yellowish joint-clay.
    - 10 feet sand, mixed with some clay.
    - 6 feet gravel, sand, and clay, which seem to overlie the limestone, and in which water was obtained; total depth, 40 feet.

In the western portion, where the sandstones and sandy shales are more developed, it may be more difficult to obtain water; still there are sufficient beds of clay. But the creeks in that portion become dry in summer, because the drainage by these coarse loose sandstones is too rapid, and they retain only some stagnant water in pools.

The Coal-Measures and Permian rocks contain all the ingredients necessary to produce excellent soils, and their stiff clays have been much improved by a mixture with the finely arenaceous deposits which have been swept over the surface from the west. From the above sections it will be seen that the soil is mostly deep, and naturally drained by the substrata. Where, however, the drift-sand reaches too near the surface, the soil becomes too dry, and is, besides, liable to wear out, because the mineral portion of the fertilizing ingredients, once exhausted by a succession of crops, cannot be reproduced from the sand. The marls of the Cretaceous formations, Nos. II and III, can also make highly productive soils; but where the sandstone formations prevail, they are apt to cause aridity, unless the soil happens to be well mixed with the clays of other formations, a fact of which many of the farmers in the western districts had already become aware before the excessive drought of the present season.

The farther we progress westward the more the surface-deposits increase, especially on the uplands, and the country assumes the character peculiar to the following section. The productiveness becomes impaired by the prevalence of arenaceous material and the deficiency of atmospheric precipitation.

The timber is confined to the water-courses, but forests will probably soon spring up at numerous points, as they have done in other parts of the Western States since they have been settled.

Building-material, rock, and good clay for brick, can generally be obtained within convenient distances, and among the clays of the Carboniferous formation, in the eastern part of the district, good fire-clays may be discovered.

Small seams of stone-coal have been found in the Upper Coal-Measures, which can, however, be worked only to a limited extent by "stripping," and it is not likely that extensive thicker beds will be discovered. At some points the lignites which have been observed in connection with the ferruginous sandstones may be of workable thickness. The middle and lower series of the Coal-Measures, as developed on the Missouri River, in the State of Missouri, contain, however, several strata of excellent bituminous coal, which we have little reason to doubt continue far westward at a depth still accessible by well-conducted mining operations on a large scale. As long as a limited demand does not warrant extensive and costly enterprises, the want must be supplied from outside, and farmers would do well to cultivate timber, as they have to do in other prairie countries.

No valuable minerals of any kind are likely to be found in this district, the geological formations not being favorable to their development. Only in Southeastern Kansas, beyond the limits of the district under consideration, outliers of the lead-bearing rocks of Southwestern Missouri might occur.

SECTION II.

THE PLAINS.

GENERAL REMARKS—FROM LITTLE BLUE RIVER TO THE FORKS OF PLATTE RIVER—THENCE TO ABOVE ASH HOLLOW; PROBABLY A PLIOCENE TERTIARY FORMATION—LITHOLOGICAL AND CHEMICAL CHARACTER OF THE ROCKS—FOSSILS—SAME FORMATION AT OTHER POINTS—FROM ASH HOLLOW TO BEYOND SCOTT'S BLUFFS, PROBABLY OF MIOCENE AGE—GENERAL CHARACTER OF THE FORMATION—SUCCESSIVE SECTIONS ABOVE ASH HOLLOW; COURT-HOUSE ROCK, CHIMNEY ROCK, SCOTT'S BLUFFS—FOSSIL TURTLES AND MAMMALS—THENCE TO FORT LARAMIE—TERTIARY STRATA OF VARIOUS AGE—ECONOMICAL GEOLOGY—SOIL—FUEL—BUILDING-MATERIAL.

This section comprises the whole area from the western limits of Section I, on our route near the Little Blue River in Southeastern Nebraska, to the eastern foot of the Rocky Mountains, near Fort Laramie. The surface configuration and general aspect of this district have been described so frequently, that I can confine myself to point out briefly the geological features. It is exclusively occupied by recent formations of Tertiary and Post-Tertiary age, the bulk of which, if not all, are fresh-water sediments. They have not been subject to violent local disturbances, but have been raised, as a whole, by the great continental upheaval, which must have taken place during or at the close of the Tertiary period, and the principal changes which they have undergone are merely effected by erosion. It is difficult to draw distinct limits between the various subdivisions, because the lithological character of fresh-water deposits is variable within short distances; and thus the continuation of the same beds may, at a distant point, appear like an altogether different formation.

Along our line of travel, from east to west, up Platte River, we come successively from the most recent to older strata.

FROM LITTLE BLUE RIVER TO THE FORKS OF PLATTE RIVER.

From the Little Blue to the forks of Platte River we find no rocky strata. The surface is covered with heavy arenaceous deposits, part of which are Post-Tertiary, apparently of the age of the "Bluff" formation, while other portions are, perhaps, older, Pliocene-Tertiary. Along Little Blue River, and in the upland toward Platte River, we find a great thickness of "Bluff" or "Loess" formation, which, also, covers the older rocks, over extensive areas much further to the east. It is there a buff-colored, or light-brownish, finely-grained, earthy argillo-arenaceous sediment, uniform throughout the whole thickness, and contains small *Gasteropoda*, *Helix*, *Lymnea*, &c.

On Platte River, near Fort Kearney, the hills are more sandy and undulating, and no exposures were noticed; but from above the fort to the forks of Platte River deposits are most characteristically developed, which may either form the continuation of the Bluff formation, or may be of Pliocene-Tertiary age. They consist of an arenaceous, light-brownish, or buff-colored material, of mostly a very fine grain, and nearly free of calcareous and argillaceous portions. This sand contains, apparently, the same little shells as the Loess, and exhibits, at some points, indistinct marks of stratification, a slight change in the fineness of the material, or darker lines which indicate a growth of plants during intervals of its formation. Where best developed, this sand rises in high perpendicular walls, and is worn into a maze of intricate ravines, forming a peculiar and frequently highly picturesque scenery. It attains a considerable thickness; single exposures are 200 and more feet high. I had observed the same formation on the Republican River, from the mouth of Frenchman's Fork upward, and along Arickaree Fork to Rock Creek. Dr. Hayden has given a section of the Tertiary strata of White and Niobrara Rivers, in a preliminary report on Lieutenant Warren's expedition in Nebraska and Dakota (Annual Report of Captain Humphreys, Office of Explorations and Surveys, December, 1858, p. 119); but there the strata seem to be developed somewhat differently. Those deposits, which I have designated as Loess, correspond to the Post-Pliocene deposits of that section, the description of which, however, scarcely corresponds to the strata above Fort Kearney on the Platte. The difference may be due to local influences, and the latter strata, perhaps, include the uppermost portion of Dr. Hayden's Pliocene bed, F.

FROM THE FORKS OF PLATTE RIVER TO ABOVE ASH HOLLOW, ON THE NORTH PLATTE.

Near the junction of the North and South Forks of Platte River, the first rocky strata were observed. They continue along the South Fork, cropping out at intervals at one or the other side of the river, and were found most developed in Ash Hollow, where they attain a thickness of over 250 feet. This series is composed of an alternation of loose, finely sandy, and of harder rocky strata, the latter consisting of fine or coarse drift-sand, generally cemented by carbonate of lime, forming more or less calcareous sandstones, and gritty, very impure limestones. Partly they are coarse sandy, partly finely earthy or even on the fracture, and a few are subcrystalline. Their age is, probably, the Pliocene-Tertiary; but I have no paleontological proof of it. They have evidently been deposited before the last great continental upheaval; while they present such an unfinished and recent appearance, that I am inclined to consider them as among the latest formations of the Tertiary period. Moreover, they appear to answer the description given by Dr. Hayden in his above-named section, of the Pliocene strata, F 3. I can, however, not recognize other portions of his No. F in the formations which I have observed on that portion of Platte River.

There is no strongly-marked line between these deposits and the next ones, which are probably Miocene.

The first rock, at the forks of Platte River, is composed of drift-sand mixed with carbonate of lime, and partly porous and not much indurated, partly compact. It is overlaid by the loosely arenaceous deposits described before. The porous kind was found to contain—

Carbonate of lime	45 per cent.
Sand, silica, and some alumina	55 per cent.

In Ash Hollow these strata vary much in appearance; some are white, nearly subcrystalline, and somewhat chalky, irregularly intermixed with loose, sandy portions; in the purer pieces the sand is fine, and can only be recognized by dissolving the rock in acid. Others are buff-colored, of a fine grit, coarse grit, compact, or loosely cemented; a few are even conglomeratic.

In the most calcareous of such rocks, from various localities, I found, by analysis

(Lieutenant Bryan's explorations, 1856, Rep. Sec. of War, 1857), 40 to 65 per cent. of carbonate of lime, while the average contain scarcely a few per cent., and only some select pieces can really be considered as limestones. The softer strata are either purely sandy, or they contain, besides, some lime, generally in chemical connection with silica, and not uniformly mixed through the whole mass, but forming irregular concretions and veins, and root-like bodies. Such concretions I found to be scarcely acted upon by hot concentrated hydrochloric acid, and to consist of—

Silica	79.0 per cent.
Alumina, with traces of peroxide of iron	10.0 per cent.
Water, apparently in chemical combination	4.5 per cent.
Magnesia	1.5 per cent.
Carbonate of lime, mostly in the mineral, as calcia	6.0 per cent.

Many of them, however, contain much more carbonate of lime, and are rather a mixture of carbonate of lime with sand and silicate of calcia.

At a few points only, the lime throughout the stratum has entered into chemical combination with the sand, as in these concretions. Such a specimen, resembling chalk, from the north bank of the South Platte, gave—

Silica	45.5 per cent.
Alumina	15.5 per cent.
Water, partly hygroscopic	14.5 per cent.
Carbonate of lime	13.5 per cent.
Calcia	11.0 per cent.

The stratification, in general, does not differ much from the horizontal; there seems to be a very slight dip to the east. In the details, however, it is irregular; the harder and softer, or coarser and finer, portions of the strata vary considerably in their relative thickness. What appear to be rocky strata are frequently no separate layers, but merely concretionary seams. Wherever large masses of the bluffs have become detached and fallen down, and thus new faces have been formed, they appear quite uniform, without a distinct stratification. After some time, however, the softer portions wear out under the atmospheric influences, while the harder ones, distributed in more or less horizontal lines, are left protruding, and thus indicate the stratification; but as the harder and softer portions are not regularly distributed in the mass, this false stratification is deceptive, and apt to lead to great errors in the estimation of the thickness and extent of the strata.

In these rocks, near the forks of Platte River, I found numerous fossilified seeds of the size of a small cherry-stone, apparently related to the living genus *Celtis*, which have improperly been called *Lithospermum*, which name belongs to a very different living genus of plants. The same were noticed, together with a *Helix*, a few miles above the mouth of Ash Hollow. On the northern bank of the South Platte, 14 miles below the crossing, a silicified fragment of a large bone was obtained; but I am not able to decide whether it originated from these strata or had been washed out from others of a lower geological horizon, higher up the river (see below). At some points these strata contain numerous concretions of sand, of a peculiar shape, part of which are so much like bones of large animals, that many people have been deceived by them.

The same strata were observed by me, in 1856, further south on Rock Creek, a branch of the Republican River, near longitude 102°, where I found similar seeds, and at some points northeast from there, on the upland, toward South Platte River. I then was inclined to consider them as Post-Tertiary. A similar formation, lower down on the Republican River, below the mouth of Frenchman's Fork, and thence to near longitude 97° 20′, may be of the same age, or perhaps a little older. The strata on Lodge Pole Creek, near the Pine Bluffs, present a similar character, and are probably of the same age, or only little older. They are, partly at least, more regularly stratified, and some of them are conglomeratic, or coarse-grit stones; but such differences may be occasioned by the geographical distance of the two points. There I also found the seeds of *Celtis*. The more conglomeratic portion may, however, correspond to No. E of Dr. Hayden's section.

FROM ASH HOLLOW TO BEYOND SCOTT'S BLUFFS.

From Ash Hollow westward, the strata gradually assume a different appearance, and instead of being calcareo-arenaceous they become more purely arenaceous, and finally argillo-arenaceous. The main body of the formation is made up of the very finest, light-brown, or buff-colored sand, with a slight admixture only of clay, just enough to make it hold together, and stand in vertical exposures. Only the lower strata are a little more clayey. But there are interstratifications of coarser sand and sandstones, in which the cement, however, is not carbonate of lime, and which mostly form no regular continuous beds. These strata present numerous precipices and high cliffs, with vertical bare walls and turreted appearance, some of which have attracted the attention of every traveler, and are known as prominent landmarks. On account of the variability of their character it is more difficult to trace their superposition than it would appear on a superficial examination; and the dip does not seem to be quite uniform throughout, but it is generally a few degrees to the east. All my observations combined, leave, however, no doubt that this formation is older than the Ash Hollow series; and the remains of animals in the lowest portion of these strata, near Scott's Bluffs, seem to indicate that it is of the age of the White River formation, viz, Miocene-Tertiary. The total thickness of this series is probably not much less than 1,000 feet, or even more.

At the mouth of Ash Hollow the lowest 30 feet are occupied by a stratum of buff-colored, finely arenaceous material, with no visible cement, but rather compact, capped by the calcareous sandstones. Up the river the arenaceous bed, or beds, rise more and more, and exhibit occasionally harder portions of the same color, like irregular rocky interstratifications, although these are not very prominent. Within 14 miles they attain an altitude of nearly 200 feet, indicating a rise of about 12 feet per mile more than the fall of the river. In a prominent bluff there the stratification is indicated by steps or terraces in the bare escarpment, on which the sand is mostly a little coarser and better cemented, but more in concretions and irregular seams than in distinct layers, and without changing much the uniform appearance of the face. The upper 10 feet are compact sandstone, and the bluff is capped by some strata of the calcareous drift-stone. Near by, a few ledges of a calcareous sandstone, with softer interstratifications, were also noticed near the water-level.

Farther on more rocky interstratifications were observed in the bluffs. If the dip continues unchanged, as appearances seem there to indicate, these strata underlie the last-mentioned exposure; still I hesitate to make a positive assertion. The difference in the appearance might be owing to a slight local change in the development of these strata, because, wherever the arenaceous material has not been the very finest, such seams and concretionary masses of sandstones have been formed. The prevailing color of the rock continues to be the light brown and buff.

The Court-house Rock, about 55 miles from the mouth of Ash Hollow, and 6 miles south of the river, on Lawrence Fork, presents the following section:

1. 10 feet, middle fine-grained, compact sandstone forming its top.
2. 40 feet arenaceous strata, with irregular concretionary ledges of harder sand-rock, coarser than the main body of the strata, and forming steps in the escarpment.
3. 10 feet, a thicker stratum of such sandstone.
4. 50 feet, finely arenaceous, and some argillo-arenaceous material, forming vertical escarpments, but rather soft and not rocky.
5. 10 feet more solid, and a little coarser sandstone.
6. 50 feet fine, loose material, like No. 4, with the two white chalky strata, in which there is a good deal of calcareous substance, and a stratum of coarser loose sand.
7. 105 feet finely arenaceous strata, with interstratifications of more argillo-arenaceous shales.
8. 30 feet buff-colored argillo-arenaceous shales, containing far more sand than clay.

Three hundred and five feet is the total altitude above Lawrence Fork, which would probably correspond to 450 feet above Platte River.

The Chimney Rock is about 11 miles, in a straight line, distant from the Court-house Rock, in west-northwesterly direction. About 2 miles from the river it rises above the sandy hills, presenting a huge column on a conic base. It is remarkable how this slender spire of rather soft rocks could have been preserved in its isolated position, while the same formations all around were demolished. Its upper part is cleft asunder, and threatens to fall down. That it has been higher, and the uppermost portion has been destroyed, within the memory of now living men, may be no idle story. The masses of rock which cover the base correspond to those of the highest strata in the vicinity, and can only have come there by falling from the chimney. A short distance from it we find the bluffs with which it has unquestionably been connected in former times. The following section of the strata was obtained, partly at the Chimney Rock, partly, where I could not climb higher there, from the corresponding strata of these bluffs, which exceed it in height by 130 feet:

a. 130 *feet—the top of the bluff*, not altogether well exposed.

1. 130 feet loose, grayish, and buff-colored sandstone, of a middle fine grain, irregularly interspersed with concretionary masses of a harder sandstone, and with more regular, thicker seams of it, generally forming steps in the slope, 10 to 15 feet apart. The lowest 30 feet form one step, with only a ledge of such rock on top, besides the irregular masses which are dispersed through it.

b. 115 *feet—the chimney itself*, with a diameter of about 50 feet at the base, and only slightly tapering upward.

2. 5 feet, light brownish-gray, loose, middle fine-grained sandstone, with some harder seams, especially on top, where there is also a thin calcareous ledge, like 9.
3. 10 feet, similar loose, middle fine sandstone, free of harder seams and concretions, and of light brownish-gray color.
4. ⅔ foot, seam of hard, finely-grained sandstone, of irregular thickness.
5. 12 feet loose sandstone, like 3.
6. 30 feet, like 2, with irregular, harder seams and concretions, capped by such a harder ledge, varying in thickness from ½ to 1½ feet.
7. ⅓ foot bluish-gray, not very compact, sandstone.
8. 7 feet like 3.
9. ½ foot white seam, areno-calcareous, partly chalky, partly subcrystalline.
10. 12 feet, like 3.
11. ½ foot, white seam, like 9.
12. 15 feet, like 3.
13. 1 foot, like 3, but dark gray.
14. 19 feet, like 3, but light gray and laminated.
15. 2 feet, like 3, in places more or less whitish and slightly calcareous.

c. 223 *feet—the conic base and the pedestal.*

16. 45 feet; dark buff-colored, purely arenaceous shales, so largely developed in the sections given above, and forming also the pedestal.
17. 110 feet; the same, light buff-colored.
18. 8 feet; white, very light rock, chalky and irregularly interspersed with fine sand. It is a mixture of sand with silicate of lime, and quite similar to the rock from the South Platte, an analysis of which has been given on page 261.
19. 60 feet, like 17; the upper portion more argillaceous.

d. Below the base in a ravine.

20. 35 feet, like 7.
21. 5 feet middle fine, gray, loose sandstone.

The total altitude of the Chimney Rock from the base is, therefore, 338 feet; that of the whole section 506 feet; and the elevation of No. 21 above the river may be put down at 60 or 100 feet.

The white stratum, No. 18, may still be seen at the foot of the Perpendicular Bluff, some miles farther west. In Scott's Bluffs it is a few feet above the highest point of the road in the gap, but is there more grayish and arenaceous. Below it we again find the buff argillo-arenaceous strata, No. 19, but here rather more clayey; and the higher layers also correspond to those enumerated above. The height of the white stratum here is estimated at 200 feet above the river, about the same as at Chimney Rock; the stratification, therefore, appears to correspond to the fall of the river. The total altitude of Scott's Bluffs is about 525 feet, including nearly the whole of the preceding section, and some lower strata.

The arenaceous and areno-argillaceous shales continue down to the river, interstratified with a few irregular seams of calcareous or harder and coarser arenaceous material. In these strata highly-interesting organic remains have been discovered lately—fossil turtles and the bones of various mammals. Traveling in forced marches, we were unluckily prevented from collecting much. Some of the bones were submitted to the eminent osteologist, Prof. Joseph Leidy, of Philadelphia, who kindly volunteered in examining them. He recognizes them as belonging to *Deinistis felina*, a large carniverous animal related to the weasel, and to some ruminant pachyderm, perhaps *Oreodon*, which both, like the turtles, occur also in the Miocene formations of the bad lands of White River. The lithological character of these strata seems, likewise, to be similar, and indications are strong that both formations are of the same age, and have perhaps been deposited in the same basin.

In the banks of a ravine, in the lowest strata of the above section, the bones of a huge animal have been found. A Mr. W. W. Wright, of Minnesota, discovered them, and brought to Fort Laramie two leg bones, nearly complete, each over 30 inches long, and a femur. When we passed there on our return, Captain Simpson caused some excavations to be made at the same spot, and we obtained a large shoulder-blade, some vertebræ, ribs, fragments of the ivory of a large tusk, &c. Unfortunately the bones are in a friable condition, or else probably a large portion of the skeleton could have been secured. Although their state of preservation differs from that of the remains of the smaller animals, which are silicified, the former are apparently of the same age, or rather slightly older.

The fossiliferous strata are among the lowest of this series. The next outcrops which I observed on the river present a different character.

If we compare again the above-mentioned section of Dr. Hayden with the formation which we have just described, we find that, although they are not exactly alike, still they show a marked resemblance. The strata in the lower portion of Scott's Bluffs correspond to his turtle and Oreodon beds, B; the next higher one to his C, with the difference, that we find the calcareous matter more concentrated in a few beds; and D is represented by the upper portion of the Chimney Rock section. Dr. Hayden estimated the thickness of B, C, and D at 480 to 580 feet. On Platte River the thickness of this formation is much greater, but then we may have there his bed E, which is between 180 and 200 feet thick, replaced by more finely-grained deposits. If that is not the case, then F must be wanting on the Platte, while farther southwest, on Pole Creek, it is again considerably developed. Dr. Hayden's extensive collections have led to the conclusion that all these beds are probably of Miocene-Tertiary age, and the stratigraphical evidence, which alone I can adduce, does not conflict with this opinion.

FROM ABOVE SCOTT'S BLUFFS TO FORT LARAMIE.

Above Scott's Bluffs still lower strata gradually rise to the surface. They present a decidedly different appearance, but were only seen in scattered outcrops, mostly of no great extent. They are made up of a series of variegated, green, gray, buff, whitish, and reddish argillaceous and arenaceous shales, alternating with sandstones, and some few limestones; and their age must be the Lower Miocene or Upper Eocene. They are probably the same formation which has been observed on Platte River, some distance above Fort Laramie, and may correspond to the *Titanotherium* bed, No. A of Dr. Hayden's section, which he provisionally considers as Miocene. Future investigation can only furnish the elements from which the actual age of this formation can be determined.

The sandstones are partly similar to those in the upper part of the Chimney Rock section, compact or friable, partly more coarse-grained, in consequence of the vicinity of the mountains, which must have existed, although in different profile, at the time of their formation. The few intercalations of limestone do not preserve a uniform character. Some are highly compact and brittle, with an even or conchoidal fracture, and full of seams, and irregular secretions of agatized silex or opal; others are subcrystalline or granular; still others slaty. In an argillo-calcareous ledge in such limestones, 23 miles below Fort Laramie, I found some fossils, *Planorbis*, *Dentalium* (?), and impressions of long, narrow leaves, probably of some grass.

Nearer to Fort Laramie I noticed prominent outcrops of a coarse, conglomeratic, brown drift sandstone, portions of which contain pieces as big as a hen's egg, and even larger. It overlies light buff, finely-arenaceous shales, such as are so extensively developed farther down the river, and is capped by a light-gray, fine-grained sandstone. These are probably local deposits, and of more recent date than those mentioned last. Captain Stansbury noticed considerable exposures of the same rock up Laramie River.

At the junction of this river with the Platte, near Fort Laramie, the hills are made up of finely arenaceous strata, light-gray, and partly white, from a large percentage of calcareous matter. Some of these are much like the white stratum in Scott's Bluffs and Chimney Rock; others are coarser calcareous or siliceous sandstones, containing concretions or irregular ledges of more compact sand-rock, like the upper members of the Chimney Rock section, and they may perhaps be of the same age, viz., Miocene; but some miles above the fort, and wherever observed farther west, they left the impression upon my mind that they must belong among the most recent Tertiary deposits, and are, perhaps, of the age of the Ash Hollow series, to which they there bear considerable resemblance, and which is probably Pliocene, or that they are partly even more recent. I did not see them capped by any other beds, but they everywhere hold the highest position, either on top of the hills or filling depressions in the older rocks, and are only modified by the latest erosions.

At various points along the eastern foot of the mountains, south of the North Platte, lignites have been discovered, as I have been informed by several officers of the Army. Not having seen them myself, I cannot determine whether they form the continuation of the extensive lignite deposits higher up on Platte River, which underlie the gray, green, &c., argillaceous shales and the sandstones described above; or, if they have been formed in a different basin; nor whether their age is the Cretaceous or the Tertiary.

ECONOMICAL GEOLOGY.

The character of the surface deposits everywhere reflects that of the substrata. As the formations of this district are prevailingly arenaceous, so are also the soils. As far as the "Bluff" formation extends at the eastern end of the section, the soils mostly contain all elements of fertility, but are rather too light and dry; and as the quantity of atmospheric precipitation also decreases westward, the limits of the arable district are reached very soon. Still, large areas are covered with a good and dense growth of various grasses, among which the short but highly nutritious buffalo-grass, *Buchloe dactyloides*, and a similar one, *Boutelona oligostachia*, are particularly worth mentioning. During the summer months they would afford fine grazing to innumerable herds, especially of sheep. Such is the case in many parts of the district, wherever the soil has a slight admixture of clay; but many hundreds of square miles are too sandy or gravelly to produce much of these nutritious grasses, and must be considered as utterly worthless. The country between Ash Hollow and Scott's Bluffs is of this nature, as are also large areas on the uplands at a distance from the river, along Pole Creek, &c.

The flat river-bottoms in the neighborhood of Fort Kearney are prevailingly sandy. Near the river the upper soil was found only 6 inches deep, light arenaceous and mixed with humus, and of fair quality; the next 4 inches consisted of such soil mixed with much sand, and the subsoil, from a depth of 10 inches down, was composed of nearly pure river-sand, with only little clay. Everywhere about there water can be struck at a depth of a few feet, and therefore the soil is kept moist, and coarse swamp grasses grow abundantly. Tillage will succeed there to some extent, and will be made to pay on account of the lively local demand of the passing traffic.

The most promising point for agriculture on that line is a limited space near the forks of Platte River, at Cottonwood Spring. At Fort Laramie the soil is dry, sandy, and poor, and but little can be grown, the more so because the season is very short, with late frosts and early snows. Small grain could probably be raised at various points in that neighborhood with the aid of irrigation. The same will apply to some valleys at the immediate foot of the mountains, off the main road.

The scarcity, and over-long stretches, utter absence of timber or fuel of any kind, except the dung of animals, have frequently been noticed. Lignite has been found in various localities south of the road, along the foot of the Rocky Mountains, but not near the road, and I have not had an opportunity to examine it; it is probably similar to that of the next section.

Building-material is very scarce in the eastern part of this district, but in the western part, at numerous points, rocks can be quarried, some of which will bear any weight, while others are fit only for light masonry. Part of the houses at Fort Laramie have been built of adobes, and such can be made wherever the strata are slightly argillaceous.

SECTION III.

THE DISTRICT OF THE ROCKY MOUNTAINS.

GENERAL CONFIGURATION AND GEOLOGICAL FORMATIONS—IGNEOUS ROCKS, GRANITES, GREENSTONES—PERIOD OF THEIR ERUPTION—METAMORPHIC SCHISTS—STRATIFIED ROCKS OF THE PALEOZOIC AGE—SILURIAN, DEVONIAN, CARBONIFEROUS, AND PERMIAN FORMATIONS—STRATA OF DOUBTFUL AGE—TRIASSIC AND JURASSIC FORMATIONS—JURASSIC STRATA IN THE BLACK HILLS AND ON PLATTE RIVER NEAR THE RED BUTTES—SECTION OF THE STRATA—THEIR RELATION TO THE CRETACEOUS FORMATION NEAR LA BONTÉ CREEK—SECTION OF THE TRIASSIC ROCKS—THEIR RELATION TO THE JURASSIC AND CARBONIFEROUS STRATA—EVIDENCE OF THEIR TRIASSIC AGE—CRETACEOUS FORMATION—LIGNITE FORMATION—ITS LITHOLOGICAL CHARACTER—ITS AGE—SAME FORMATION FARTHER SOUTH—TERTIARY FORMATIONS OF DIFFERENT AGE—ECONOMICAL GEOLOGY—AGRICULTURE—BUILDING-MATERIALS—COAL, IRON, SALTS.

This section comprises the country from the eastern foot of the Rocky Mountains to the divide between the waters of the Atlantic and Pacific Oceans, from Fort Laramie to the South Pass. The Rocky Mountains in this latitude do not form those compact mountain masses, rising abruptly to a great altitude from a narrow base, and presenting nearly insurmountable barriers, as they do farther south at the Parks; but they have divided into various branches, trending mostly in a western or northwestern direction, and thus they have decreased in altitude and flattened out. There are some considerable elevations, such as the system of the Laramie Peak and the Wind River Mountains, but most of the ranges, although generally presenting bare and rugged declivities, form only quite narrow spurs, which at numerous points fall off entirely, and at others lose their rugged character, and only appear as gentle upheavals of the stratified rocks, with broad, flattened crests. Between these ranges the country is comparatively level, and partly covered with nearly horizontal deposits, and even where it is rough and broken it can scarcely be called mountainous, and presents a surface configuration very different from what it is generally supposed to be in the region of the Rocky Mountains.

The mountains are partly covered with a thin growth of pine, but near the road most of them are entirely bare of timber, or nearly so, and frequently they exhibit rugged walls of granite or other rocks, with scarcely a particle of soil or detritus upon them. The flat portion of the country is an extensive sage-barren, but there is grass along the creeks, and more of it is scattered on the uplands between the sage. The latter grass is of a highly nutritious kind, which the animals like very much, even when it is dry.

Although the main emigrant-route to California and Oregon passes through this section of country, little has hitherto been known of its highly interesting geological features. Besides igneous rocks of different age and metamorphic strata, there are Silurian, and probably Devonian, Carboniferous, Cretaceous, and Tertiary formations; and we have, moreover, found decidedly Jurassic strata, which seem to be developed here over a considerable area. A short time ago the first indications of Jurassic formations have been observed on an expedition under Lieutenant Warren, Topographical Engineers, in the spur of the Black Hills north-northeast of Fort Laramie, by Mr. Meek and Dr. Hayden; and farther west, near the junction of the Wahsatch and Uintah

Mountains, I found more indications of rocks of this period (see section IV), which, therefore, must have a wide range. As they contain highly fossiliferous beds, it is remarkable that they have never been noticed before. Underlying these Jurassic strata there is a gypsum-bearing formation, mostly made up of red, shaly sandstones which in all probability belongs to the Triassic period.

All the strata of this district, even the most recent of the Tertiary formations, have undergone some dislocations, but these latter, like the Tertiary formations of section II, have been raised uniformly as a whole, and overlie, nearly horizontally, the older rocks.

The mountain ranges mainly consist of the upheaved older formations, which have partly been considerably altered, in connection with igneous and metamorphic masses, while in the valleys the more recent strata predominate. We find, however, Cretaceous and Tertiary strata crowning some of the main divides at South Pass, Bryan's Pass, &c.

THE IGNEOUS ROCKS.

Effusions of igneous masses have taken place in this district at different times, partly at an early period, probably toward the close of the Paleozoic era, partly at a much later date. We have evidences of it in the unconformable superposition of the strata of the various periods, combined with the difference in the mineralogical character of the eruptive rocks. These belong to at least two quite distinct groups, the granitic group and the greenstones.

Granites, composed of feldspar, quartz, and dark-colored mica or black hornblende and granitic syenites, closely related to them, form the main body of the eastern chain of the Rocky Mountains south of Fort Laramie, between the North and South Platte, and much farther on. Similar rocks are extensively developed near our route. They were observed in the mountains of the Laramie Peak system, on the divide between Bitter and Horseshoe Creeks, and farther west, near Prele Creek; also in the mountains south of the road, west of Deer Creek. They entirely form the Rattlesnake Mountains from near the mouth of Sweetwater River to the Three Crossings, and part of the Sweetwater Mountains. According to Colonel Frémont, the Wind River Mountains have also a granitic center.

The granitic rock from Horseshoe Creek appears to be composed of reddish-white orthoclase, milk-white oligoclase, quartz, and black mica, which are the normal elements of true granites. That from the Sweetwater Mountains and Rattlesnake Mountains is quite similar, and nearly all the specimens obtained from rocks *in situ* present the same appearance. This, as well as the parallelism and close connection of these ranges, indicates that they are only different spurs of one mountain system. A specimen from Independence Rock contains whitish pellucid orthoclase, a little white oligoclase, much quartz, and greenish-black mica; also some particles of specular or magnetic iron-ore, a frequent occurrence in connection with the eruptive rocks of this district. Only at two points I observed somewhat different granites forming small outcrops.

Among the loose drifted pieces of granitic rocks we find a great diversity of color and composition. They seem to originate from the neighboring mountains, but none of them were observed *in situ.* With them I found pseudomorphous green-colored quartz, shaped after feldspar. Near the South Pass I noticed fragments of a granite containing white mica. As I have not seen any similar rock in these mountains, except in bowlders at Bryan's Pass, southeast from the first locality, and again farther on in the same direction on Cache-la-poudre Creek, a tributary of South Platte River, I suppose that such granites form part of the western branch of the Rocky Mountains, extending from the Park Mountains to the Wind River Mountains. On the west side of South Pass I observed, however, granite, *in situ*, similar to that of the Rattlesnake Mountains.

The greenstones evidently date from a later period than the granites, in which they frequently form dikes. They are composed of white feldspar and green hornblende, and appear to be related to the diorites. Some of them are finely crystalline, and the two minerals can readily be distinguished. In others the hornblende prevails so much that the white feldspar can only be seen on the weathered surface of the rock. Still others are subcrystalline, and form a homogeneous mass of dark greenish-gray color, which is produced by the mixture of the white with the green mineral, the mixed powder of which appears greenish-gray.

These latter rocks can easily be mistaken for basalt, and I should not be surprised if most of the rocks in these mountains which have been described as basalts should, on a closer examination, be found to be such dioritic greenstones. The lithological character of part of these greenstones, especially of the latter description, is such that loose pieces of them cannot well be distinguished from metamorphic slates, hornblende slates, and the like, and their eruptive origin is only proved by their position in dikes. Similar rocks, which are evidently metamorphic, occur on our route and in the adjacent districts. On Horseshoe Creek I noticed pieces of a hornblende rock, with a peculiar concretionary structure like the "schaalstein" of Germany, in which the hornblende seems to envelop numerous small concretions of the size of lentils, and which therefore presents an undulated surface. If not found together with other hornblende rocks which appear to be eruptive, I would at once put it down as metamorphic; but, under the circumstances, not having seen it *in situ,* I hesitate to express a decided opinion.

Greenstones have been observed at various points, between Horseshoe Creek and the Rocky Ridge, a short distance east of the South Pass. They are best exposed on Sweetwater River, in the Rattlesnake Mountains, where they cross the granite in numerous dikes, and can easily be seen on account of the bareness of these mountains. At Devil's Gate I noticed one on each side of the road, and several others near the Gate. One vein has, in former times, filled a large portion of the gap, and may have given origin to it by its disintegration.

From the limited number of observations which could be made in regard to the relative position of strata of different age and the igneous rocks, it has not been possible to determine the exact period of the eruption of the granites and greenstones. The granites are undoubtedly very old. Similar rocks in the eastern hemisphere are not positively known to have disturbed any other than Paleozoic formations, and this seems also to be the case here. The Carboniferous strata have certainly been tilted by the granites, and have been altered in consequence of this eruption. As I could not trace the limits between them and the strata which we refer to the Triassic formation, I cannot decide whether both hold the same relative position to the granites or not, but I am strongly inclined to the opinion that the Triassic rocks are not directly tilted by them.

Other disturbances of the strata succeeded at various times in connection with the changes of the formations. At some points the Triassic, Jurassic, Cretaceous, and more recent strata appear to be conformable; at others, however, we find evidences that upheavals and erosions have taken place in the mean time, and the period of the last general continental upheaval is the close of the Tertiary era or even Post-Tertiary, of which the position of the more modern Tertiary beds affords conclusive proof. It is doubtful whether more than one of these disturbances was accompanied by outbursts of eruptive masses within this district, as we have not observed any plutonic rocks of a more modern appearance than the granites, except the greenstones. The origin of the latter most probably coincides with a second great uplifting of the Rocky Mountain chains, which seems to have occurred toward the close of the Cretaceous or early in the Tertiary period, while the last great changes of the level do not seem to have been accompanied by any violent disruptions of the strata and outbursts of eruptive masses in this section of the country.

THE METAMORPHIC ROCKS.

Many of the older formations of this section have undergone considerable changes in their lithological character, by the immediate influence or secondary consequences of the eruption of the igneous rocks; but completely metamorphosed strata or originally crystalline schists are extensively developed only in the western part of this section, between the Three Crossings of Sweetwater River and the South Pass. On Sweetwater, above the crossings, I observed mica schist, mainly composed of dark-colored mica and quartz, with a laminated texture, also gneiss, made up of white oligoclase, quartz, dark-colored mica, and hornblende (?) with a coarse crystalline granitic texture, and other rocks of a similar character; also some hornblende rocks which may, however, be of eruptive origin. On the Rocky Ridge, east of the last crossing of Sweetwater River, I noticed more outcrops of gneiss (and perhaps granite?), and some of the hornblende rock; but the western portion of this ridge appears to consist chiefly of argillaceous and silico-argillaceous schists, part of which assume a micaceous character, without, however, changing into mica schists. They continue westward, and form numerous outcrops on the eastern slope of the South Pass, until they disappear beneath the capping Tertiary strata. According to Colonel Frémont they thence extend northwestward in the Wind River Mountains.

Similar metamorphic strata, but especially a hornblende slate, are extensively developed some distance south of our route, in the Medicine Bow Mountains. In the eastern portion of this section, at least near the traveled road, there are only few indications of metamorphic strata. I have mentioned that some of the hornblende rocks near Horseshoe Creek may belong to that series, and perhaps also some south of the road, near Prele Creek, where I observed a curious alternation of granite, a crystalline or compact greenstone or hornblende slate and quartz rock.

STRATIFIED ROCKS OF THE PALEOZOIC AGE.

Strata which evidently belong to the older formations have been observed at numerous points, tilted by the igneous rocks; but few of them contain fossil remains, the traces of which have mostly been obliterated by a beginning metamorphosis. Thus we have not been able to determine the age of more than a few of them.

Silurian formation.—I have not observed myself any decisive proofs of the existence of the Silurian formation in this district; but some time ago an unquestionably Silurian coral, *Halysites catenulata* (*Catenipora escharoides*), was found by Mr. Drexler at the Rocky Ridge, a few miles north of the main road. This fossil is generally confined to the upper division of the Silurian formation, and has hitherto been found only in a few specimens lower down, in the upper portion of the Lower Silurian formation. This coral of Mr. Drexler is the first Upper (or Middle) Silurian specimen ever found in the far West. As Dr. Hayden has recognized the Potsdam sandstone, which is at the base of the Lower Silurian, or probably more correctly primordial, farther east in the Black Hills, north of Fort Laramie, (Prel. Report of Lieutenant Warren, Top. Eng. Doc., 1858–1859), we may presume that the Silurian formation occurs at intermediate points along the mountains, but has not been recognized on account of the scarcity of the organic remains.

Devonian formation.—As yet it is not certain whether the Devonian period has any representatives in this section of country. We find it stated in Captain Stansbury's report, that, West of La Bonté Creek, some fossils were obtained which appeared to be Devonian, but we are now able to prove their Jurassic age.

Near the Medicine Bow Butte, at the southeastern extremity of the Laramie Plains, I found, on a previous expedition, a loose, drifted mass of rocks, full of fossils. Dr. B. F. Shumard, who examined them, expressed the opinion that they were Devonian. He says (Expl. of Lieut. F. T. Bryan, Top. Eng., 1856, Rep. Sec. of War, 1857): "They are Paleozoic types, belonging to the genera *Spirifer*, *Chonetes*, *Orthis*, *Orthoceras*, *Conocardium*, &c. They were very badly preserved, and their specific character almost wholly obliterated. From their general appearance, however, I am strongly of the opinion that they represent the Devonian period." As, heretofore, no strata of that age had been observed at any point of the far West, there was still room to doubt the correctness of this conclusion; but since this expedition has proved an extensive development of Devonian strata in Utah Territory (see section V), we may well presume that a more detailed examination will reveal their existence also in this section.

Carboniferous formation.—Rocks of the Carboniferous formation have been observed at several points in the eastern portion of this district. They had first been recognized by Captain Stansbury and Professor Hall, and contain the same organic remains as the Upper Carboniferous formations in the Mississippi Valley. Fossils of this age have been found at the following points along the route:

1. At the Warm Spring Creek, about 13 miles west of Fort Laramie, where limestones are quarried for the use of the fort. The rocks are hard, brittle, mostly subcrystalline, altered limestones and marbles, partly siliceous. They are gray, or variegated gray and red, and contain numerous *Brachiopoda*, especially *Productus*, also *Corals*, and joints of *Crinoidea*, &c.

2. On North Platte River, some 15 miles above Fort Laramie, and some miles farther west, where the road strikes Horseshoe Creek. The rocks there are partly like those of the quarry, partly siliceous altered sandstones, &c.

3. Captain Stansbury obtained Carboniferous fossils at a point some distance south of the road, not far from Prele Creek.

Similar rocks are considerably developed near these localities, but have not furnished any fossils to our collection.

Permian formation.—Hitherto in this part of the Rocky Mountains no strata have been conclusively identified with the Permo-Carboniferous formation of the Eastern Kansas or the truly Permian period.

Strata of generally much altered rocks, the exact age of which could not be determined on account of the scarcity or total absence of fossils, but which apparently belong to the Paleozoic periods, are largely developed in the mountain-ranges of this district. They cap the granites of the Black Hills, far north and south of Fort Laramie. On our routes, we found them on the Platte River, from some miles above Fort Laramie to the upper end of the cañon near the first crossing of the river road. Part of these rocks have already been mentioned among the Carboniferous. I noticed highly altered light-colored sandstones, partly calcareous, or veined with agate, siliceous limestones with secretions of flint and jasper, marbles of various colors, some purple sandstones, &c. They contain traces of fossils, but more perfect ones were only obtained at the localities mentioned above as Carboniferous. Such rocks also crop out at numerous points south of the river, and toward Laramie Peak. On the upper road we find them on Bitter Creek, and on the mountains east of La Bonté Creek.

On La Bonté Creek, some distance south of the road, strongly tilted rocks form several ranges of hills, parallel to each other and to the higher mountains in the south. They present a uniform dip off the latter, and, therefore, steep escarpments in one direction, and more gentle slopes in the other. Sandstones prevail there of white, gray, and brown colors; others are purple or dark brick-red, the latter mostly rather soft. They are interstratified with arenaceous and argillaceous shales and slates; gray, green, bluish, reddish, &c. While the sandstones form the hills, the shaly strata have been more easily eroded, and correspond to the intervening valleys, which are partly occupied by more recent Tertiary formations. They trend generally to north-northwest, and dip strongly to east-northeast over 60°, and at some places they are even vertical. Near the road the trend and dip are much disturbed by local manifestations of the subterranean agencies. A short distance from La Bonté Creek we find formations which underlie Jurassic strata, and are provisionally referred to the Triassic period; and the question arises whether these sandstones and shales are not, perhaps, of the same age, or hold an intermediate position between them and the more calcareous portion of the Carboniferous formation. Further west, near Prele Creek, the mountains south of the road are mainly composed of gray and white and some light red and purple sandstones, with few interstratifications of slates and pure or siliceous limestones. Their dip is variable but strong. They are apparently also Paleozöic. Captain Stansbury obtained there some Carboniferous fossils. The valley of Platte River is generally occupied by more recent formations, and the higher mountains with the older rocks are several miles distant. Near Dear Creek, and for some distance west from there to the Red Buttes, they are partly granitic, but mostly composed of upheaved stratified rocks. At the Red Buttes we find more Triassic outcrops.

The mountains south of Sweetwater River, west of the Devil's Gate, are also mostly granitic, with altered Paleozoic rocks on their slopes. On the east side of the Rocky Ridge I found the last outcrops of this age. They are then succeeded by metamorphic schists.

TRIASSIC AND JURASSIC FORMATIONS.

To within a short period it has been problematical whether the Jurassic and Triassic formations were represented in the territory of the United States, although Middle Jurassic strata are known in the Russian territory, on the northwest coast of this continent. Their discovery was repeatedly claimed, but every time it was found that a mistake had been made. Although some of the strata which Mr. J. Marcou described as Jurassic and Triassic are, perhaps, of that age, still he based his conclusions chiefly upon fossils which have since been recognized as Cretaceous forms, and nearly the whole area which he colored upon his map indiscriminately as covered by those formations, is now well known to be Tertiary and Cretaceous.

On an expedition under command of Lieut. G. K. Warren, Topographical Engineers, in the year 1857, Dr. Hayden collected, in the Black Hills, north of Fort Laramie, a series of fossils, in which he and Mr. Meek recognized the Jurassic formation. The full report of this exploration, and of the highly interesting geological discoveries connected with it, has not been published yet, but a short account of them has been given in a "Preliminary Report of Lieutenant Warren, Washington, 1859, Doc., Secretary of War," and in a paper read before the Academy of Science of Philadelphia, March, 1858.

Our observations fully confirm the conclusion in regard to the Jurassic age of that formation. At various points I observed strata which are evidently coeval with those described by Dr. Hayden, and occupy an analogous position between the Cretaceous and older beds. A few of the fossils of our collection, a full description of which is given in the subjoined report of Mr. Meek, are identical with those of Dr. Hayden, while we have, also, several new ones which, like his, are closely allied to European Jurassic forms. The only disputable point is now, to which horizon of the Jurassic series these strata correspond. Mr. Meek suggests that they are Liassic, basing his opinion chiefly upon the similarity of several of Dr. Hayden's fossils with European species of that age, while our fossils, although from strata which apparently form the continuation of those observed by Dr. Hayden, seem to be more closely related to Middle Jurassic types. We have an *Ostrea*, scarcely distinguishable from *O. Marshii* (*O. Engelmanni*, Meek), a leading type of the Middle Jura of Europe; while a *Pecten* is very similar to *P. lens* (*P. bellastriata*, Meek), which does not occupy a distinct horizon, and furnishes, therefore, no proof *pro* or *contra*. *Belemnites densus*, Meek, has a slight ventral groove, and is thus allied to the *Canaliculati* which are characteristic of the Middle Jurassic formation, and it is perhaps not distinct from *B. eccentricus*, Blainville, of that period. In order to settle this question of age it will, however, be necessary to wait until more complete collections of fossils and accurate sections of the strata can be procured.

All the Jurassic fossils which I obtained in this section of the country were found on North Platte River, close below the Red Buttes, within a few feet of each other, in some strata highly charged with organic remains, and which reach the surface at the lowest central point of an anticlinal exposure. A combination of local upheavals, which cause abrupt changes of the dip, both in direction and degree, and the disconnection of the exposures, prevented me from obtaining a complete section, and from tracing the limits between the Jurassic and older formations; while the overlying strata, at a greater distance from the axis of elevation, have such a slight dip, and are mostly covered over so much with soil and detritus that their succession and relative superposition are not perfectly plain. The difficulty is increased by the scarcity of fossils, of which I did not notice any between the point mentioned and a locality 7 miles lower down the river. The succession of the strata along the river, as far it could be observed, is the following, beginning about 7 miles below the Red Buttes:

1. Dark gray and blue argillaceous slates and marls, with harder seams and concretions of argillo-calcareous marl, the latter mostly inclosing fossils, *Ostrea congesta*, *Baculites*, and a fine new *Inoceramus*, of great size, *I. Simpsoni*, Meek. Fissures of the rock are thickly coated with slender silky crystals of gypsum. These beds, forming an exposure of about 70 feet thickness, evidently correspond to No. III of the Nebraska-Cretaceous section of Messrs. Meek and Hayden, and appeared to be horizontal.

2. A gap probably corresponding to more clays and marls.

3. Sandstones, heavy-bedded, light-colored or brown, and ferruginous, passing down into thinly stratified, partly shaly sandstones, and still lower into brown and gray arenaceous shales, with some seams of sandstone. The observed thickness exceeds 100 feet, and may be much greater. The dip is very slight to the east. These sandstones closely resemble those of the Lignite formations, as well higher up as lower down on Platte River. I did not notice with them any beds of coal, but numerous imperfect marks of fossil plants.

4. A great thickness of sandstones, like the upper ones of No. 3. Underlying them conformably, there are—

5. Dark bluish-gray, apparently altered shales and slates, with irregular seams and concretionary masses of black limestone, which have an even fracture and are hard and very brittle, as if they had passed through a kiln. Seventy feet or more.

6. A remarkable bed, 6 feet thick, of a light greenish-yellow argillaceous substance, which is unctuous to the touch, and readily imbibes water, which renders it highly plastic. It contains gypsum in single crystals and alkaline salts.

7. Over 150 feet more of the dark shales and slates, like 5, with efflorescences of gypsum on the fissures.

8. Sandstones, conformably underlying the shales, of considerable thickness.

9. Shales and slates, dark bluish-black, or light-colored, variegated gray, red, green, &c. About 100 feet.

10. Some beds of brown and gray sandstone, partly slaty, laminated, and calca-

reous, and changing into a gritty, impure limestone. It is fetid, from a large amount of organic remains. This is the rock just referred to, in which I found the Jurassic fossils. It contains one or two species of *Belemnites*, *Pentacrinus*, *Dentalium*, two *Pecten*, two *Ostrea*, a *Gryphæa*, some indistinct fragments of other *Acephala*, and also what appears to be worm-tracks.

11. More shales like 9.

The relative superposition of these strata is not altogether plain, as I have stated above, and from this enumeration of their geographical succession, together with my other field-notes, two different geological sections may be formed. I am not positive which of the two is the correct one. The main point upon which the question hinges is whether Nos. 3 and 4 are Upper Cretaceous, corresponding to the Cretaceous sandstone and Lignite formation higher up on Platte River, or if they are Lower Cretaceous, corresponding to No. 1 of the Cretaceous section of Nebraska, of Messrs. Meek and Hayden.

If the latter view is correct, then the strata appear to be enumerated in our section above in the order in which they actually overlie each other, beginning with the highest. The dip, although slight at that point, appears to be uniformly in the same direction.

Dr. Hayden, in the paper mentioned above (Proc. Acad. of Phil., March, 1858), gives a section of the strata near the Black Hills, in which he assigns this same position to a series of rocks very much like our Nos. 3 and 4. He finds in them, besides indistinct vegetable remains, also seams and layers of dark carbonaceous matter or impure lignite, which I did not observe in Nos. 3 and 4 below the Red Buttes, although lignite may, perhaps, exist in those strata. I found seams of it a few miles west from there, which may possibly occupy this horizon. Farther west, in the Wahsatch Mountains, I have also observed a considerable sandstone formation containing some beds of brown coal, overlying Jurassic strata (see section IV). The few fossils found there point decidedly to the Lower Cretaceous, (or, possibly, even Jurassic) age of that series, and although differently developed, according to local circumstances, it is most likely coeval with No. I of the Nebraska section. These observations, showing that the sandstones at the base of the Cretaceous formations of Kansas and Nebraska extend with increasing thickness to the western limit of the secondary formations in these latitudes, corroborate the opinion that Nos. 3 and 4, although no fossils have been found in them from which to determine their age, may represent that same horizon.

Nos. 5 and 7 of the above section evidently belong together. As no fossil remains were noticed in them, it must be left to further investigations to decide whether they are Jurassic or Cretaceous. In their lithological character they resemble the following Jurassic strata.

The stratum No. 6 is unlike any common rock or shale, and its present condition seems to be due to chemical agencies. I would certainly consider it as quite local, if I had not seen exactly the same substance, in connection with similar shales and slates, on a previous expedition under Lieut. F. T. Bryan, Topographical Engineers, some 80 miles south from there, near the Medicine Bow Buttes. In a piece of it, which had lost all its soluble parts, gypsum, &c., I then found 30 per cent. of alumina, 51 to 55 per cent. of silica, traces of calcia, and much water, which was retained with great force, even when the mineral was heated.

Nos. 8 and 9 then probably correspond to the lowest portion of No. 1 of the Black Hill section, while No. 10 is lithologically similar to Dr. Hayden's A, the highest bed which he considers as Jurassic.

On the other hand there are so many local upheavals in the neighborhood of our section that it is not necessary to consider the strata as altogether conformable. Our No. 1, corresponding to No. III of the Nebraska Cretaceous section, may be an outlier; it has not been observed anywhere lower down on the river. Nos. 3 and 4 may represent the sandstone formation with lignites of the Upper Cretaceous age, of Nos. IV or V of the Nebraska section, which is most characteristically developed farther south on the North Platte, and of which more will be said below. That no beds of coal have been seen cropping out is no proof against their existence, and, besides, the beds of coal are not uniformly distributed throughout the whole thickness of that formation. Nos. 5, 6, and 7 are precisely like some strata which I had, in 1856, observed near the Medicine Bow Butte, resting there upon a gritty limestone which resembles closely our No. 10, but is characterized by its fossils as an equivalent of No. II of the Cretaceous section. They then may form part of No. II or of III. That they are altered, while the other portion of No. III, several miles lower down the river, is not altered, would not be a sufficient evidence against their common age, and the apparent absence of fossils in 5 and 7 is only the result of the metamorphic agencies. No. 5 may, however, occupy a lower horizon than No. 1. No. 8 may be an equivalent of Nos. I or II the Cretaceous section, while with 9, probably, the Jurassic formation begins. A thorough investigation on the spot is required before the question of the relative age of all these strata can be settled.

In Captain Stansbury's report it is stated that a few miles west of La Bonté Creek, north of Laramie Peak, gray sandstone was seen cropping out, overlying the red sandstone which we refer to the Triassic age. Above these were layers of red and light-colored shales, impure limestone, and shaly and thinly laminated sandstone, with some *Brachiopoda*, *Monotis*, &c. These strata were considered as probably Devonian. Besides the fact that the genus *Monotis* is not known to range so low down, it will be seen from the following that the red sandstone spoken of underlies our Jurassic strata, and that the fossiliferous beds are on a parallel with, or at least closely allied to, our No. 10. They also present the same lithological character, not met with in the more recent rocks of this neighborhood, and are therefore probably of Jurassic age. In the mountains south of the Three Crossings of Sweetwater River, I noticed rocks which are petrographically similar to some of the Jurassic beds, and may be of the same age.

Either immediately below No. 11 of the above section, or after a repetition of similar shales and calcareous laminated sandstones of no considerable thickness, the strata near the Red Buttes continue downward in the following order:

12. Gray sandstone, which I did not examine closely, but noticed only from a distance. It corresponds apparently to No. C of the section of Messrs. Meek and Hayden. It occupies the top of the principal of the Red Buttes, probably, together

with some of the higher strata, to a thickness of about 100 feet, and also caps some of the mountains west of La Bonté Creek. Its age is probably the Jurassic.

13. Purple slaty and shaly sandstone, with thin interstratifications of other colors, green, blue, &c., 150 to 200 feet.

14. Some gray sandstone, and much purple slaty sandstone and arenaceous shales, with a thin interstratification of an impure siliceous limestone, and much gypsum; the latter partly in strata, of which there are at least six at the principal butte, each of them over 2 feet thick, partly disseminated throughout the arenaceous material in thin scales and seams, 150 to 200 feet.

15. Hard siliceous sand-rock of considerable thickness, which may belong to an older formation.

The rocks Nos. 13 and 14 do not retain their character unchanged, as is common with such formations. Near La Bonté Creek, the second locality where they are well exposed, I noticed with them heavy beds of white and light-yellowish, fine-grained, friable, quartzose sandstones, and the gypsum is there distributed somewhat differently. The petrographical features of Nos. 13 and 14 are similar to those of No. D of Dr. Hayden's Black Hill section, which is by him there provisionally referred to the Carboniferous period, but in regard to which he states: "It is not easy to determine the age of the bed D. From its stratigraphical position, as well as lithological characters, it might with almost as much propriety be referred to the Permian or Triassic systems as to the Carboniferous." Underlying it he observed beds of bluish and reddish gray, very hard, gritty limestone, 10 to 50 feet thick, No. E of his section, in which he found a smooth, Spirifer-like shell, and *Pleurotomaria*, *Macrocheilus*, and *Bellerophon*, the two latter of which genera are unknown in the Old World in strata above the Carboniferous, but have, in Eastern Kansas, been also found in the Permo-Carboniferous formations. It appears, therefore, that all below No. D of the Black Hill section is Permian or Carboniferous, and, from the remark of Dr. Hayden, "that near the southeastern base of the Black Hills some loose masses of a cherty rock were seen on more than one occasion, under circumstances indicating that the stratum from which they were derived holds a position between the beds C and D, and that several of the fossils which they contain are identical with species occurring in a formation in Northeast Kansas, now known to be of Permian age," it would seem that D is also Carboniferous or Permian. The close similarity which appears to exist between the strata D and Nos. 13 and 14 leads me to suppose that the latter observation may be erroneous, as I hesitate much to refer Nos. 13 and 14 to the Permian age. It is, however, possible that they are altogether distinct.

In the Black Hills, according to that section, the Paleozoic formations appear to be developed on a small scale only, much less than I have observed them near our line of travel, and before further south, and again further west in the Wahsatch Mountains, where they attain a thickness of many hundreds of feet (see section V). It would seem that this is due more to the nature of the upheavals, and perhaps powerful denudations and erosions, than to a difference in their original development. An apparent conformability does by no means involve a positive evidence of undisturbed successive deposition. I have, at numerous points, as well on this expedition as before, noticed heavy masses of brick-red, soft sandstones in connection with the Carboniferous rocks of the Rocky Mountains, which I consider as much older than the beds Nos. 13 and 14, and the lithological similarity alone is a very deceptive evidence of the contemporariness of the formation. I have not observed gypsum with these, but the gypsum is in many instances a secondary formation, which did not originally exist in the rocks where it now occurs, and may, therefore, be found in formations of every age.

Thus far we have no positive evidence of the age of Nos. 13 and 14 of the above section. Such formations contain usually few organic remains, either because the chemical properties of the acid waters in which they may have been deposited did not favor the existence of animal life, or because their traces were obliterated subsequently by chemical agencies connected with the formation of the gypsum. I only found in them the impression of what appears to be the sheath (*ochrea*) of a leaf, such as is, to my knowledge, not known in the Paleozoic era, and is first observed with plants of the Triassic epoch. At the points where I noticed these strata, they are closely connected with Jurassic rocks.

At La Bonté Creek, where the formations underlying them are largely developed, there appears to be a very considerable thickness of strata between them and the limestones of the Carboniferous period, of which I have spoken above, and which is composed chiefly, as far as we could ascertain, of sandstones of white, gray, and brown, brick-red, and purple colors, the latter mostly soft shaly, with interstratifications of variegated shales and slates. Not having had sufficient time for more extended examinations in that interesting locality, where the stratification is much disturbed by local upheavals, I dare not express a decided opinion in regard to the age of this apparently intervening series. I am inclined to think that we have there Permian or Triassic rocks, not observed before developed in a similar degree and with the same features.

An additional evidence of the probably Triassic age of Nos. 13 and 14 is found in the large development of similar gypsum-bearing areno-argillaceous formations further south, in Northern Texas and New Mexico, where they also underlie Cretaceous beds, as stated by Mr. Marcou, Dr. G. Shumard, Mr. Blake, in the reports of Captain Marcy, Captain Pope, Captain Whipple, and others, and in the interesting discoveries made along the Great Colorado and its tributaries by Dr. Newberry, on the expeditions under Lieutenant Ives, Topographical Engineers, in 1858, and Captain Macomb, Topographical Engineers, in 1859. Dr. Newberry there discovered in such formations some plants of the genera *Zamites*, *Petrophillum*, &c., and Saurian bones, which led him also to refer this series to the Triassic epoch. (See American Journal, vol. 28, second series, page 299.) Similar formations are largely developed in the southern part of the Wahsatch Mountains. (See section IV.)

The gypsum evidently existed as such before the eruption of the greenstones. On La Bonté Creek, where the irregularity of the stratification is caused by intrusions of the greenstone, I observed that a thick bed of gypsum, which is considerably bent, has thereby been broken and brecciated, and exhibits numerous fissures radial to the curvature.

In connection with the Triassic formation, I have observed some very instructive instances of complicated stratification, produced by the combined effects of multifarious upheavals.

CRETACEOUS FORMATION.

The middle and lower portions of the Cretaceous formation are not prominently developed along our route. I have, in the foregoing chapter, mentioned that this division of the Cretaceous strata, No. III, and, probably, also Nos. I, II, and IV of the Nebraska section, are exposed above the Jurassic rocks between the Platte Bridge and the Red Buttes, and I have described their character. Farther eastward the overlying Lignite formation covers the surface. Only about two miles above Deer Creek, I noticed gray and brown laminated, impure sandstone, with shaly portions and carbonaceous particles, and found in it some imperfect fossil bivalves, which are referred by Mr. Meek to the genus *Panopaea* and the upper part of the Cretaceous system. The lithological character of the rock corresponds to that of the upmost Cretaceous beds—No. V of the Nebraska section—which are described as yellow arenaceous and argillaceous grit, containing much ferruginous matter; it also closely resembles that of some portions of the Lignite formation. Loose pieces of a hard, brown sandstone, with a species of *Inoceramus* (see Mr. Meek's report), which seems to indicate that the bed from which they come holds a position at the base of No. IV of the Cretaceous section, have been found at several points near the last-mentioned locality, some distance higher up on Platte River, and again a few miles west of the Red Buttes. These specimens apparently have not been drifted far, but I could not ascertain from which strata they come.

I am led to consider the Lignite formation on Platte River, along our route, as Upper Cretaceous, corresponding to the one near Bryan's Pass and the Medicine Bow Butte.

The Cretaceous formation is considerably developed farther south in this section of country. While with Lieutenant Bryan, Topographical Engineers, in 1856, I have observed beds, corresponding apparently to No. IV, on the eastern slope of the Black Hills, near the South Platte. Speaking of them, I remarked (Report Secretary of War, December, 1857, p. 510): "Near the place where Cache-la-poudre Creek breaks through the last chain of rocks to enter the plains, I observed in the sandstones interstratifications of altered sandy shales and shaly limestones. Some of these were highly fossiliferous, full of remains of fishes and shells, and fetid from the large amount of organic matter. The fossils are, however, preserved badly. They are undoubtedly Cretaceous." One of them appears to be *Inoceramus Sagensis*, which, in Nebraska, is confined to the upper part of No. IV.

No. III was then found largely and characteristically developed along Sage Creek, an affluent of North Platte River, near the divide between Platte and Green Rivers, and also on the northeastern side of the Medicine Bow Butte. No. II was observed south of that butte: "There were several layers of a finely-grained, subcrystalline, fetid limestone, which is in some places even bituminous, from the large amount of organic remains which it includes. Other portions contain a great deal of micaceous sand, so much so as to change it into a micaceous sandstone." Fossils were abundant, and evidently of Cretaceous age. Lately the specimens from there have again been carefully examined, and the result shows that this formation is No. II of the Cretaceous series. An *Ammonites* is closely allied to *Ammonites percarinatus*, which occurs in No.

II (more so than to *A. Mandanensis*). Other fossils are young specimens of *Scaphites larviformis*, and still others *Inoceramus fragillis*, both forms of which are in Nebraska confined to No. II. This rock is overlaid by rotten slates and shales, which cannot be distinguished from Nos. 5, 6, and 7 of the foregoing section, and are equally abnormal in their appearance.

LIGNITE FORMATION.

On the Upper North Platte, near Sage Creek, and at Bryan's Pass, and extending east to beyond Medicine Bow Creek, I had then observed a heavy formation of sandstones, including a considerable number of beds of brown coal. In this formation, which reposes upon No. III, in a stratum immediately above one of the coal-seams, I found a number of marine shells, some *Inoceramus*, of which one specimen appears to be *I. tenuilineatus*, which occurs in No. IV, some *Ostrea*, of which one at least is a new species, &c., and from the same series, higher up, I obtained specimens of *Cytherea*, and the characteristic *Avicula Nebraskana*, Evans and Shumard, which occurs in Nos. IV and V of the Nebraska section.

A Lignite, or, rather, brown-coal formation, also occupies a large portion of the country along Platte River from below Deer Creek to near the Red Buttes, and north and south from there. It is mostly composed of white and light-brownish sandstones and argillaceous shales and slates; in the upper portion, also, of arenaceous shales and shaly sandstones. The most eastern point where I noticed it is where the hill-road west of Fort Laramie enters the valley of Platte River, and in the low bluffs some miles below that point. Here I observed light-colored sandstones, mostly not very compact, interstratified with argillaceous and some arenaceous shales of light and dark gray, bluish, and brown colors, and with seams of carbonaceous shales and brown coal. Even the sandstones contain in places particles of coal. The dip is not uniform—from 15 degrees upward.

Up Platte River the formation gains in thickness, and more coal was observed. Heavy strata of mostly white sandstone, alternating with argillaceous shales and slates, and with numerous seams of coal, form prominent escarpments along the river, between Deer Creek and the Platte Bridge. The seams of coal are mostly thin. At one point five of them were observed within a height of less than fifty feet, most of them only from 6 to 10 inches thick; but the shales above and below them were highly carbonaceous and full of vegetable remains, and some of them might be called impure, slaty coal. At other points the carbon appears to have more accumulated, and the seams become thicker, until they form workable beds of coal. A bed of coal on Deer Creek, near the road, is over 6 feet thick, and has long been known, and occasionally been worked for blacksmithing. A description of the coal will be given below.

The trend and dip of these strata are variable; mostly off the nearest mountains, and near Platte Bridge, it is toward the east, so that lower strata rise to the surface above that locality. The thickness of the formation cannot be estimated with any degree of accuracy, but must be considerable, and may reach several hundred feet.

Some sandstones nearer the Red Buttes, No. 3 of the above section, closely resemble those of this Lignite formation, but may perhaps be older. On the ridge, some miles west of the Red Buttes, the road passes by some prominent exposures of white and brownish sandstone, associated with gray and brown shales and slates, and dipping at an angle of 45 degrees to southwest. Interstratified with them I noticed several beds of coal, of which one, immediately underlying the most prominent stratum of sandstone, appears to be several feet thick. The coal was covered with detritus, and I could only obtain some weathered fragments by digging with the knife. It appears to be similar to that of Deer Creek, and is probably of the same age. Its stratigraphical position also leads to this conclusion.

I cannot definitely decide, from the evidence found on our route, whether this Lignite formation is Eocene-Tertiary or Upper Cretaceous, yet it is almost certain that it corresponds to the Cretaceous Lignite formation higher up on Platte River of the age of No. IV or V of the Nebraska section.

I have only obtained a few fossils, and it is not altogether certain whether they actually come from strata of this formation, or from outliers of the Cretaceous beds. It is certainly older than the Miocene formation, and therefore older than the Great Lignite Basin on the Missouri River, which is now generally conceded to date from that period. It is older than Miocene, because we find the Miocene era represented lower down on Platte River by the Scott's Bluff formation (see section II), which is apparently coeval with the Miocene strata of the Bad Lands of White River, and overlies another series of Tertiary strata (see below), which, in their turn, overlie the Lignite formation. No Miocene strata in this part of the country have ever been observed in a disturbed condition, strongly tilted by forces from beneath, while the Platte River lignites have frequently been noticed dipping at an angle of 45°. Another Lignite formation on the Missouri, near the mouth of Judith River, is characterized by its organic remains as Eocene-Tertiary (see various publications of Mr. Meek, Dr. Hayden, and Prof. Leidy). It is considerably disturbed by subterranean agencies, like the Platte River strata, and although the latter are much more and differently developed, this may be the result of local circumstances, and both might perhaps be of the same age (?).

The Platte River formation overlies Cretaceous deposits of the age of No. III of the Nebraska section. A few indications of Nos. IV and V were also noticed, and I am strongly inclined to the opinion that the Lignite formation occupies the horizon of No. IV or V, the same as the not far distant Lignite formation higher up on Platte River, and forms the continuation of it; holding possibly a similar position in relation to the Cretaceous and Tertiary periods, as do the highest Carboniferous strata in Eastern Kansas, between the Coal-Measures and Permian formations (?). Not far from Deer Creek (see above, under Cretaceous formation), I have found in rocks containing particles of coal some casts of fossils which Mr. Meek refers to *Panopœa*, and considers as evidences of the Cretaceous age of the beds in which they occur, the lithological character of which corresponds as well with the decidedly Upper Cretaceous as with the Lignite formations with which they are surrounded.

Close by, and at several other points higher up the river, also near the outcrops of lignites west of the Red Buttes, I have found fragments of *Inoceramus* loose on the surface in a very compact brownish sandstone. This rock is exactly like some of the sandstones of the lignitic series. I have not noticed the *Inoceramus* in the rock *in situ*, and they may possibly have been drifted there; but it is remarkable that they should have been found several times near the lignites, if they are not connected with them.

The Upper Cretaceous brown-coal formation which is developed farther south, in the district of the Rocky Mountains, on the Upper Platte River, Sage Creek, and Bryan's Pass, and which I have mentioned already above, presents a similar general development, only slightly modified by local influences, especially in its upper division, and is composed of an alternation of white, gray, yellowish, and brown sandstones, with some argillaceous slates, brown and gray argillaceous and arenaceous shales, and layers of brown-coal mostly from 6 to 24 inches wide.

Taking all these evidences together, very little doubt remains in my mind that the Lignite formation on Deer Creek should not be of the same age as that on Sage Creek, viz, Upper Cretaceous, and it would require positive evidences to convince me of its connection with the Tertiary Lignite formations farther north.

TERTIARY FORMATION.

Overlying the lignite series we find a succession of strata, which, if we may judge from their color and the material of which they are composed, are probably coeval with those underlying the Miocene (Scott's Bluff) formation below Fort Laramie (compare section II). They extend on Platte River, from the eastern limits of the Lignite formation, to the point where the river begins to cañon and the road crosses back from the north to the south side, and perhaps lower down. They consist of a series of argillaceous shales of drab, green, and gray colors, gray sandstones of a rather fine grain, and some coarse sandstones mainly composed of particles of granite mixed with agate and hornblende rock. The shales contain numerous arenaceous concretions, which, where they are more numerous, form distinct irregular strata. At some points such seams of rounded masses, each only a few inches thick, alternate regularly with seams of clay of about the same thickness, and thus the bare bluffs attain a singularly striated appearance, only interrupted by heavier strata of sandstone. Their stratification is nearly horizontal, and they thus appear to be unconformable to the lignite series. They seem to dip slightly to the east, so that, traveling down the river, we gradually come to higher strata. The whole thickness of the formation does not seem to be more than 200 to 300 feet, but could not be estimated closely. It forms table-hills with precipitous sides, and I did not observe any fossils. The upper or eastern portion is more arenaceous; the buff-color prevails in it, and some of the sandstones are quite conglomeratic, probably on account of the proximity of the higher mountains.

Near Fort Laramie, below the cañon of the Platte, a more recent Tertiary formation is extensively developed in the river-valley and in the adjoining hills, which has been observed also close below the fort, and has been mentioned in section II. It is mainly made up of finely arenaceous strata, which are light-gray or whitish, from an admixture of calcareous substance. Some strata are coarser calcareous or siliceous sandstones, partly concretionary and irregular, like the rocks of the Ash-Hollow formation; but they are generally more friable, and do not form the same fine scenery. The soft arenaceous strata contain, at many points, numerous irregular root-like white bodies, composed of sand and carbonate of lime, or silicate of calcia, which I have also mentioned in connection with the Ash-Hollow rock, and which have occasionally been mistaken for fossils.

Similar formations were noticed far to the west, and, wherever observed, they hold a position which makes it evident that they are among the most recent deposits of the Tertiary period; some of them may even be Post-Tertiary. They are nowhere capped by any others—generally fill depressions in the older rocks, creek-valleys, &c., and are only modified by erosion. Near Fort Laramie they form considerable bluffs, but attain generally less thickness along the road. I observed them in the hills west of Laramie, near Bitter Creek, &c.; also again on the ridge between the Red Buttes and Independence Rock, and at numerous points of the Sweetwater Valley. These deposits naturally change according to the character of the surrounding mountains from which they are formed; they become coarser, conglomeratic, or more argillaceous; therefore, we find strata of a different appearance, but apparently of the same age, in the mountains near Horseshoe Creek, La Bonté Creek, &c. The Tertiary strata in the South Pass will be described in the following section No. IV.

ECONOMICAL GEOLOGY.

Agriculture.—This section of the country is considerably elevated. The lowest points cannot be less than 4,500 feet high, which is given by Captain Stansbury as the elevation of Fort Laramie. This altitude, combined with the climatological character of this region, the remarkably great and sudden changes of the temperature, and the shortness of the summer season, are disadvantageous to agricultural pursuits, but not more so, it would appear, than in the Salt Lake country. The prevalence of sandstone formations is felt unfavorably in the composition of the soils, but I have no doubt that there are numerous points, especially along the creeks, where cultivation would prove successful, although the country at large must remain a desert as long as the present physical conditions last.

Building materials are abundant throughout the district. Rocks, marble, lime, clay for adobes and brick, and even timber, in limited quantity, can be obtained nearly everywhere within a few miles of the road, and at some points there is plenty of it.

Iron.—Iron-ore appears to be largely distributed in the Rocky Mountains. Several of the granites contain the specular ore in so large a quantity that pure pieces of it can be broken off, and we may presume that deposits of the mineral exist with the granites. Pieces of siliceous specular ore, more or less mixed with slate rock, have been frequently noticed among the drift pebbles, and appear to originate from the metamorphic schists or altered rocks. Thus far, however, we cannot conceive how the iron-ore in this region should ever be turned to any use.

We have not observed indications of other mineral veins, nor of gold-bearing rocks. The geological formations at some points appear to be similar to those of the Park Mountains, in the neighborhood of Pike's Peak; but we have so little reliable information in regard to the geological configuration, and the association of the gold in that district, that we cannot now draw a parallel. Long before the gold excitement began in that country, I have heard it stated that some grains of gold had been found in Medicine Bow Creek, but nobody ever succeeded in finding more of it. Still it might be premature to deny its existence altogether.

Salts.—Along some parts of the road, especially near Sweetwater River, we find the soil in places covered with saline efflorescences and salt-ponds, which mostly dry up in summer and leave white incrustations on the surface. These salts are partly carbonates with an alkaline base, partly sulphates, especially of soda and magnesia, not to mention the gypsum, which effloresces from many of the rocks. In Captain Stansbury's report these salt-ponds have been mentioned, and the incrustation of one of them, near Independence Rock, is stated there to be composed of about 58 per cent. of sesquicarbonate of soda, besides sulphate of soda and muriate of soda, which is the composition of the salt called "trona," also found in the natron-lakes of Hungary, Africa, &c.

I took several specimens of such salts in that neighborhood, and have subjected them to a few tests before the blow-pipe. One of them is mainly sulphate of soda, free of carbonic acid and chlorine; another one contains in addition a little carbonate of soda and probably also of magnesia, but no chloride; and a third one sulphate of soda, with a large percentage of carbonate of soda, and some little chloride of sodium, and is similar to the trona mentioned above, although from a different locality.

These salt-ponds, with their concentrated brine, cause the death of large numbers of cattle, which prefer to drink this water because it is salt, and because they always like more to drink from standing pools than from swiftly-running streams. The effect is not sudden, but after the poison has staid some time in the body death follows after a few hours of sickness. The strong and fat are affected as well as the weak and lean. Citric acid and vinegar are said to be antidotes, and we can well account for their beneficial influence; a dose of oil or bacon may likewise be successfully administered.

Coal.—We have seen that coal abounds along Platte River. It is inferior to the stone-coal of the Carboniferous formation, but partly, at least, it is a superior brown coal and a very valuable fuel. In its appearance it is similar to stone-coal, of black color, and mostly great luster, while others present a dull black surface. The streak and powder are dark brown, which is also the color of weathered pieces. When fresh it splits into cuboid fragments, but after being exposed for some time to the atmosphere it becomes laminated. I have not made any tests of the Deer Creek coal, but on a former occasion I have analyzed a coal of the same formation from the Upper Platte River, which closely resembles it (see Lieutenant Bryan's report of 1856), and found in it, by distillation, with slowly increased heat—

45.5 per cent. of fixed carbon;
5.0 per cent. of ashes, partly gypsum;
49.5 per cent. of volatile substance and water.

The coal which I have examined was obtained near the outcrop, and, therefore, not quite fresh. In the interior of the stratum it may be more bituminous. It burned with a long flame, retained its shape in coking, and did not cake at all; on the contrary it split in every direction. The coke was hard and brittle, dark gray, with a metallic luster; it would not withstand much pressure, nor well endure transportation without much loss by slacking. The heating power of such coal is less than that of the stone-coal of the Carboniferous formation, and in weak traveling forges this coal from the outcrops frequently does not afford a good welding heat, but with arrangements specially adapted to it, it can be made to produce the highest heat required in the manufacture of iron. For high furnaces the coke would probably not have sufficient cohesion. It would seem to be less fit for locomotives than for stationary machines, on account of the large grate-surface which it requires; but this obstacle could certainly be overcome.

SECTION IV.

THE GREEN RIVER BASIN.

LIMITS AND GENERAL CONFIGURATION AND FEATURES—NO IGNEOUS AND METAMORPHIC AND PROBABLY NO PALEOZOIC ROCKS—TERTIARY FORMATIONS: THE FORT BRIDGER SERIES—STRATIGRAPHICAL POSITION—SECTION OF THE STRATA—THEIR ORGANIC REMAINS AND EXTENT—THEIR FRESH-WATER CHARACTER AND AGE—THE ROCKS EAST OF GREEN RIVER—THE ESTUARY FORMATION ON BEAR RIVER—OTHER TERTIARY DEPOSITS—CRETACEOUS, JURASSIC, AND TRIASSIC FORMATIONS: IN THE GREEN RIVER VALLEY—ON SULPHUR CREEK—ANALOGOUS STRATA AT THE MOUTH JUDITH RIVER IN NEBRASKA—ON BEAR RIVER AND MUDDY CREEK—AT THE NEEDLES—ON WHITE-CLAY CREEK—ON ECHO CREEK—ON WEBER RIVER AND ITS EAST FORK—JURASSIC FORMATION ON THE SOUTH SIDE OF THE UINTAH MOUNTAINS, ON POTTS'S CREEK AND DUCHESNE FORK—COAL IN SAN PETE VALLEY AND NEAR LITTLE SALT LAKE—THE RED SALT AND GYPSUM FORMATION OF PROBABLY TRIASSIC AGE—ECONOMICAL GEOLOGY—AGRICULTURE—BUILDING MATERIAL—COAL—PETROLEUM—MINERAL SPRINGS—METALLIC ORES—SALTS.

In this section I have comprised the country from the dividing ridge between the Atlantic and Pacific waters, to the eastern limits of the so-called Great Basin. On our line of exploration, it extends from the South Pass to the geological axis of the Wahsatch range of mountains, which passes near Weber River, a short distance beyond the hydrographical axis of that range. It includes the southeastern extremity of Oregon, and the northeastern portion of Utah. I have called it the Green River Basin, on account of the marked basin-shaped configuration of its surface near our route, with the same recent Tertiary strata at its lowest central point on Green River, which gradually rise toward both extremities and crown the dividing ridges at the South Pass and in the Wahsatch Mountains. Its eastern portion, from the South Pass to Green River, and even beyond, presents the character of extensive plains, scarcely interrupted by slight rises of the ground, while the western part embraces the eastern portion of the Wahsatch Mountains, the broadest and most diversified mountain-chain which we have passed on our route across the continent. There the lower formations rise to the surface; the streams have cut out deep valleys and even grand rocky cañons, and subterranean forces have manifested themselves in numerous upheavals and great dislocations of the strata, which are frequently tilted at an angle of 90° and disturbed in every direction.

The eastern portion of the district is a barren waste, rendered so by the prevailing arenaceous character of the formations, the shallowness of the soil in many places, where horizontal strata of limestone and sandstone extend over considerable distances near the surface, and the large quantity of saline efflorescences from the rocks, together with the climatical features of the country; and it would be nearly impassable if it was not for the numerous creeks and rivers which come down from the surrounding high mountains, the Wind River Mountains, the Wahsatch Mountains, the Uintah Mountains, &c., and which along their banks have seams of meadow-land, furnishing subsistence to the animals and relief to the eye tired from the endless dusty sage-barrens and sand-hills. When we approach, however, the foot of the western mountains, we perceive a great change in the vegetation. There are green valleys, diversified with groves of timber, and the mountain-sides and uplands are, besides the wild sage (*Artemisia*), thickly covered with nutritious fodder-grasses, and partly studded with cedar and pine. Still higher up, above the region of the grasses, forests of aspen and pine extend to the loftiest summits, to the region of nearly perpetual snow, greatly enhancing the beauty of the landscape.

In this district we have not found any igneous rocks, although the violent local upheavals indicate their close proximity at various points, and they are prominently developed at the eastern and western borders of the section, nor have we observed any metamorphic and paleozoic strata.

TERTIARY FORMATIONS.

We have observed several formations which we refer to the Tertiary period. Most prominently developed is

THE FORT BRIDGER SERIES,

to which we give that name because Fort Bridger is in the center of the region where it is most characteristically developed and best exposed. This series extends from the South Pass to the divide between Bear and Weber Rivers, thus occupying the greatest portion of this section. Although it consists of several subdivisions, well distinguished by the lithological character of the strata, these are all conformable to each other, and unconformable to the older formations. They are the most recent formations in this section, and we have not found them anywhere disturbed locally by upheavals, but wherever they have been noticed, they exhibit a nearly horizontal position, or rather a slight dip off the surrounding mountains toward the center of the basin. They might, therefore, be supposed to have been deposited after the country had attained its present configuration, but other observations show that this cannot be the case. While they occupy the divides in the eastern ranges of the Wahsatch Mountains and in the South Pass, seams of carbonaceous matter and numerous impressions of plants, *Ferns*, *Equisetum*, &c., which can only have grown on swampy land or in very shallow water, were found many hundred feet lower down in their continuation. Along the valley of Bear River an actual break or fault may be observed. It is evident, therefore, that during and after their formation they have undergone dislocations, not however connected with local outbursts of eruptive masses, and, undoubtedly, coinciding with the great continental upheaval at the close of the Tertiary period. This position of the strata proves that the central and western portion of the continent has not only been raised as a whole solid body, but that the mountain chains, which must have existed as such long before that epoch, have, at the same time, been elevated more than the intervening country. I compare it with the forming of a bubble. The subterranean forces gradually swelled the central part of the continent several thousand feet; the thinner portion of the surface, corresponding to the lowest points far away from the mountains, seems to have yielded most, and to have been raised high as the pressure began. Then those deposits must have been formed. When the pressure again subsided, finding, perhaps, vent in outbursts of igneous masses, and the elevation of mountain ranges at distant points, the bubble collapsed; the mountains, with their granitic centre and base, forming immense solid bodies, retained the position which they had assumed, while the thinner portions of the solid crust yielded more, and resumed the lower position which they still occupy.

This formation, as developed about Fort Bridger, presents the following section in descending order:

1. Arenaceous and argillaceous shales, slates, and shaly sandstones of green color, with interstratifications and concretions of coarser gray and green sandstone, which, at some points, form regular round bodies like cannon-balls. The lower portion contains, also, slaty sandstones and calcareous slates, and thin seams of an oolitic, fetid limestone, forming a transition to the middle portion. The thickness amounts at least to from 200 to 300 feet.

2. Limestones and argillaceous shales, also arenaceous shales, and areno-calcareous slates. The white color prevails. The limestones are partly oolitic, partly subcrystalline, with conchoidal or splintery fracture, partly uncrystalline, earthy, or chalky, also siliceous, arenaceous, and argillaceous; and many of them are fetid on account of the large amount of organic remains which they contain. Over 100 feet.

3. Light colored, mostly white, rather fine-grained sandstones, in thick beds, regularly alternating with mostly light red arenaceous and slightly argillaceous shales, and soft shaly sandstones. Over 200 feet, and perhaps considerably more. These strata may, possibly, be older than Tertiary(?).

The strata No. 1 are peculiarily apt to form prominent bluffs and table-hills, many of which are known as conspicuous landmarks. Generally one of the harder beds of sandstone forms the nearly horizontal top, while in the bare, precipitous sides the shales prevail. These shales are frequently covered with efflorescences of salts. On our road they were most characteristically developed along Black's Fork; they also form the bluffs near Green River, and the upper part of the bluffs around Fort Bridger. They gradually change into No. 2, and while the upper portion appears to contain only few organic remains, the beds of transition and No. 2 are loaded with them. On the banks of Green River I observed, in the fetid oolitic limestone, and the green slates of these beds of transition, remains of fishes, not distinct enough for identification of the species, and obscure impressions of plants; also, crystals of gypsum, and efflorescences of a salt, which proved to be a mixture of sulphate of magnesia and sulphate of soda, while other salts of this vicinity are pure sulphate of magnesia. In the same horizon, near the mouth of Harris's Fork, I observed some gray laminated slates, full of impressions of plants, mostly ferns, and, close by, brown carbonaceous shales, which might, in their continuation, form beds of lignite. The slates, becoming siliceous, form gray, brown, and black compact rocks, with numerous marks of *Equisetum*, &c., and contain seams of fibrose gypsum.

A few feet below them, between layers of green shales, there is a bed of white oolitic fetid limestone, nearly altogether composed of fossils, viz: 2 species of *Melania*, 2 of *Lymnea*, *Unio*, *Planorbis*, &c., a description of which will be found in Mr. Meek's report. The same limestone occurs in the bluff southwest of Fort Bridger (Moore's bluff), and in our collection we have specimens of it from a point 15 or 20 miles southeast of Fort Bridger, at the foot of the Uintah Mountains. Some of the limestones of No. 2, in the quarry near Fort Bridger, contain numerous traces of organic remains, teeth and scales of fishes, &c.

A piece of a fossil leg-bone, about one inch in diameter, which must, therefore, have belonged to an animal of considerable size, was found by a member of the party at the foot of a bluff far south of the road, at the base of the Uintah Mountains. From its green color it is evident that it comes from No. 1, or the beds of transition to No. 2. I was, at the time, unluckily absent on a reconnaissance with Captain Simpson, and was thus prevented from following up this trace, which might have led to the discovery of another of those vast burial-grounds of pre-Adamitic mammalian life, which have made the names of Montmartre and Nebraska famous throughout the scientific world.

On a head branch of Henry's Fork, just beyond the southeast corner of the military reservation of Fort Bridger, some 20 miles from that post, a limestone occurs with a perfectly even conchoidal fracture, and of whitish color, with siliceous secretions, and full of finely preserved *Planorbis*. Although I have not examined that locality, I have no doubt that it is on a parallel with No. 2 of the above section.

Along the road No. 2 forms the lower part of the hills near Fort Bridger. As the strata rise toward southwest, it soon attains the height of the plateau over which the road leads westward. It caps the breaks of Muddy Creek, on Captain Simpson's new road to the Salt Lake Valley, as well as on the old road by Echo Cañon. On the latter it was found a few miles farther on near the crest of high hills, and some strata at the top of the dividing ridge between Yellow Creek and Echo Creek seem to belong to that series.

No. 3 is best exposed in the more elevated western portion of the district. It forms the lower part of the bluffs along Muddy Creek; on the new road, it caps the dividing ridge toward Sulphur Creek, is then interrupted by older upheaved strata, but was found again on the western bank of Bear River, and on the top and on both sides of the dividing ridge toward White Clay Creek. On the old road it also forms the divide toward Bear River, at the Quaking-Aspen ridge, is then interrupted by tilted older formations, extends again from Bear River to the Needles, near Yellow Creek, and beyond forms part of the divide toward Echo Creek, and may extend some distance down that creek. On the western branch of Bear River these strata are found far up and down the stream, extending at least to the mouth of Yellow Creek.

All the fossils in our collection from these rocks are fresh-water forms. In my preliminary report, made at Camp Floyd in December, 1858, I had spoken of the Tertiary formation of Green River as marine. I had done this, before the fossils had been examined, upon the statement of Professor Hall, in Captain Stansbury's report, "that from the South Pass to Fort Bridger the collections are all of marine Tertiary age," which, if taken in connection with the remark of Captain Stansbury himself, that on Ham's Fork very perfect shells were collected, can scarcely be referred to any other formation than that in question. Moreover, some fossils which the same author had figured in Colonel Frémont's report, and described as probably marine shells, closely resemble some of this series, although we now think that they rather represent the estuary deposits described below.

The examination of the fossil remains has not furnished proofs from which to decide upon the subdivision of the Tertiary period to which those strata belong; but from their general character, compared with those further east, we are inclined to consider them as formed in the middle of the Tertiary epoch. No. 1 may correspond to the green, shaly series overlying the Lignite formation on Platte River above Fort Laramie, but they may just as well be altogether different, and deposited in separate basins. At another point of this district we have found beds characterized by their fossils, according to Mr. Meek, as estuary and Eocene Tertiary, which are tilted and appear to be unconformable to these, therefore, more recent strata.

From the sandstone series, No. 3, no fossils have been obtained. As nearly all the older formations on the eastern slope of the Wahsatch Mountains, from the detritus of which they must have been formed, are prevailingly arenaceous, we cannot find it strange that they should lithologically resemble portions of them and still be more modern. Wherever observed they are conformable to Nos. 1 and 2, and unconformable to the older rocks. On the Quaking-Aspen ridge they cap unconformably the strongly tilted coal-bearing strata, and on Bear River, near the mouth of Sulphur Creek, they are nearly horizontal, like everywhere else, while close by the estuary strata are strongly tilted. Although they present the general character of a somewhat older formation, this close connection with the Fort Bridger strata seems to indicate that they belong to the same geological horizon, and are only little older, perhaps Eocene. However, although they differ lithologically from the sandstones in the upper part of the Cretaceous Lignite formation, on the Upper North Platte River, near Bryan's Pass, they may possibly be coeval with them; that is, Upper Cretaceous. The greenish, shaly sandstones, which appear to cap them there (see Lieutenant Bryan's expedition, 1856), may correspond to the green series No. 1 (?). We cannot determine whether they are of marine or fresh-water origin.

From Green River eastward, the lithological character of the formation changes somewhat, although it apparently forms the continuation of the Fort Bridger strata. The prominent table-hills, near the South Pass, must be composed of the equivalents of No. 1. On the summit, and especially on the western slopes of the pass, above Pacific Springs, strata crop out, which I consider as the continuation of No. 2, but which contain a great deal more arenaceous material besides the lime, and perhaps, in consequence thereof, attain a greater thickness. They form a series of white arenaceous limestones and calcareous sandstones, with interstratifications of loosely cemented arenaceous shales and fine sand. Some of the harder ledges are compact siliceous limestones with oolitic portions, like those further west; but they are mostly a mixture of sand and carbonate of lime, and closely resemble some of the strata of the Ash Hollow series. (Section II.)

Red and green and brown coarse shaly sandstones, below the Pacific Springs, and at several points further on, appear to be a local development of the formation, near the foot of the higher mountains. Along Big Sandy I noticed arenaceous and some argillaceous shales, and lower down, some 20 miles from Green River, compact sandstones overlying fine-grained shaly sandstones of white, yellowish, and brown colors. These strata probably form the continuation of No. 3, but present a different appearance, and resemble much more the rocks overlying the Lignite formation on the upper course of North Platte River, east of Bryan's Pass, which there reaches beyond the dividing ridge into the Green River Valley.

Between the South Pass and Green River a great deal of fossil wood was observed strewn over the surface, all silicified, and some of it changed into transparent agate. It evidently comes out of this formation, probably from No. 3, and Captain Stansbury, who followed a road some miles distant from ours, actually observed some fossil trees imbedded in such sandstones, the trunks of which measured nearly 2 feet in diameter. Near there, we find stated in that report, some imperfect specimens of *Nautilus* were collected, which would indicate a marine formation, if we may not presume that these fossils either came from a drifted bowlder, or from a limestone corresponding to our No. 2, in which large *Planorbis* are found, which, when badly preserved, may readily be mistaken for *Nautilus.*

THE ESTUARY FORMATION ON BEAR RIVER.

On Bear River, near the mouth of Sulphur Creek, I observed light-colored shaly slates, gray argillaceous shales, and some strata of sandstone and limestone. The latter is partly light yellowish, coarse-textured, wholly composed of fossils, partly dark-gray slaty, also full of shells, and quite fetid. The outcrop is much covered over by detritus. These strata are considerably tilted; at one point they trend from northeast to southwest, and dip under a high angle to southeast. West of them we find the strata of the lower series of Fort Bridger, with only a slight dip; east of them, a succession of sandstones, to be described hereafter, also strongly disturbed, nearly vertical; but the disturbed condition and imperfect exposure of the rocks prevented me from tracing the exact relations between those different formations.

The fossils collected from these beds belong to the genera *Unio*, *Corbula*, *Melania*, *Paludina*, and *Melampus.* They characterize the formation as a brackish-water or estuary deposit, without any strictly marine forms. Mr. Meek, to whose report I refer for a more detailed enumeration and description of the fossils, among which there are several new ones, considers these strata as decidedly Eocene-Tertiary. The similarity of their organic remains, and their connection with the sandstone series east of them, with *Ostrea glabra* and lignites, indicate that we have here beds formed under similar circumstances with those near the mouth of Judith River, in Nebraska, of which Dr. Hayden has given an account, under the direction of Lieutenant Warren, Topographical Engineers.

These estuary beds are undoubtedly older than the Fort Bridger series, because the beds No. 3 overlie, unconformably, the upheaved mountains of which they form part, on the divide on the old road east of Sulphur Creek; and I hesitate to yield to the paleontological deductions of Mr. Meek in regard to the Tertiary age of this formation. Although, as I have stated, its stratigraphical position is not quite plain at the point where I have observed it, it appears to be closely allied to the sandstone series with *Inoceramus*, *Ostrea glabra*, and coal, which is Cretaceous, most probably Lower Cretaceous, and I am inclined to consider it as an estuary local development in that Cretaceous series. In regard to the analogous deposits of the Judith River, the reader will recollect similar doubts were expressed by Dr. Hayden and Professor Leidy in various communications to the Academy of Philadelphia. Estuary deposits are naturally scarce in all formations, but we have no reason to doubt the possibility of their existence at any horizon; and our knowledge of their fossil fauna is so very limited and so full of startling possibilities, that I am inclined to regard these paleontological deductions as less reliable, especially where few and new species are concerned, because the precedents are few.

I have noticed the formation only at a single locality. In Colonel Frémonts' report, however, Professor Hall describes a fossil from Uintah River, near latitude 41°, longitude 111°, as *Cerithium tenerum*, which is by Mr. Meek considered as identical with a *Melania* from these estuary beds, and a *Turbo* and *Natica* (?) from a point on Muddy Creek, below the crossing of the Salt Lake City road, apparently identical with *Paludinas* from Bear River, while the description of the lithological character of some of the strata of these localities rather corresponds to No. 2 of the Fort Bridger series.

Besides the two formations which have just been described, we have observed some local deposits overlying, unconformably, the older rocks, which, on that account, we provisionally refer to the Tertiary period. On Porter's Creek, the main southern fork of White Clay Creek, and less prominent on the latter stream, we find siliceous conglomerates apparently filling depressions in strata which are probably of Cretaceous age. They are composed of hard sand rock and pebbles of quartz, all rounded, varying in size generally between a hen's egg and a man's head, and imbedded in little sandy matrix, which, although easily yielding to main force, well resists destruction by atmospheric agencies. These conglomerates, therefore, form remarkable turreted bluffs and pinnacles. Their color is mostly gray. Some are brownish or reddish. They must not be confounded with the conglomerates interstratified in that older series of rocks, which have a similar appearance, but generally a more calcareous matrix. Occasionally they include more sandy portions irregularly interspersed, and on White Clay Creek I noticed them underlaid by a few strata of sandstone and shale, both together capping, unconformably, the older sandstones. No fossils have been found in connection with them.

Covering the Tertiary formation, I noticed frequently, especially on the edge of high ridges, bowlders of siliceous rocks, highly-altered sandstones, and the like, some of which contained traces of fossils which appear to be Carboniferous forms. They probably originate from the high mountains in the western part of the Wahsatch range.

CRETACEOUS, JURASSIC, AND TRIASSIC FORMATIONS.

I have already mentioned the possibility of the Upper Cretaceous age of No. 3 of the Fort Bridger series, and the probably Cretaceous age of the formation on Bear River. Along our route no strata are exposed which lithologically correspond to the Nos. II and III of the Cretaceous rocks of Nebraska; but farther south, at Bryan's Pass, I had previously observed them on the dividing ridge, beyond which they probably extend westward into the Green River country, together with the Cretaceous Lignite formation overlying them in that vicinity, and to which the coal strata appear to belong which Captain Stansbury observed at various localities on Bitter Creek. Still lower down on Green River the Cretaceous formation appears to be largely developed.

In the eastern part of the Wahsatch Mountains the Upper Cretaceous beds are not represented, except possibly by No. 3 (?). Sandstone formations prevail there entirely, consisting of more or less compact sandstones, some of which are conglomeratic, and of arenaceous and argillaceous shales, with only a few strata of limestones. Their thickness amounts to many hundreds, perhaps thousands, of feet, and their color is alternately white and red. These strata represent different epochs, the Tertiary, Cretaceous, Jurassic, and Triassic. Still, their lithological character is so uniform throughout, their stratification so much disturbed, and organic remains were obtained at so few points only, that I have not been able to draw distinct limits between them. Those of the sandstones which appear to belong to the Tertiary formation, and are distinguished from the others by their unconformable stratification, have been described above as No. 3 of the Fort Bridger series.

Underlying these latter, and in close contact with the estuary beds near the junction of Sulphur Creek with Bear River, we find along Sulphur Creek a considerable succession of white sandstones, interstratified with red and gray slaty sandstones and arenaceous and argillaceous shales. Some of these contain conglomeratic seams. They trend from northeast to southwest, and are strongly, some of them even vertically, tilted. A short distance below the crossing of the creek, on the old road, a heavy bed of reddish siliceous conglomerate forms a rugged outcrop over the crest of the hills. Close by, probably overlying it and dipping at a very high angle to southeast, I observed a yellow sandstone with *Inoceramus* similar to *I. problematicus*. A few yards farther east, above the crossing, prominent strata of white, rather fine-grained, soft sandstone, also varying only a few degrees from the vertical to southeast, contain large numbers of *Ostrea glabra*, another species of *Ostrea*, and an *Anomia*, which, by their abundance, make the rock fetid. It is immediately succeeded by coal, the nearest stratum of which is several feet thick, while at least one more follows within a few feet of the first, and is separated from it only by some gray argillaceous shales, but covered over with detritus, and not well exposed. The shales beyond it attain a considerable thickness. Another upheaval, northeast from there, then interrupts the regular succession of the strata, which seem to swing round, and to re-appear higher up the creek with reversed dip, trending from south-southwest to north-northeast, and dipping to north-northwest. At least I observed there a similar sandstone with numerous *Ostrea*, and although I did not see the coal, the supposed place of which, above the sandstone, is occupied by the bed of the creek, I found an indication of it in a hepatic spring, the like of which issues near the first coal. They apparently originate from pyrites in these coal-beds. A spring of petroleum also issues in the continuation of these strata a mile southwest of the crossing of Sulphur Creek, which latter has derived its name from those springs of sulphureous water.

The coal and the sandstone with the *Ostrea* are unquestionably members of the same formation, and the doubt in regard to that implied in a passage of Mr. Meek's report, would never have been expressed if the writer had examined that locality himself, and also the analogous one on White Clay Creek, which leaves no room for questioning the position of the coal in the middle of the sandstone series.

The paleontological evidence seems to point to the Lower Cretaceous (or even Jurassic) age of this formation, and by general considerations I am, likewise, led to consider it as such. It may be an equivalent of those strata which Dr. Hayden, on Lieutenant Warren's expedition, observed at the mouth of Judith River (see Proceedings of the Academy of Philadelphia, May, 1857), which are likewise in close connection with an estuary formation, but appear to be developed on a much smaller scale. They are also strongly tilted, contain coal and *Ostrea glabra* besides other fossils, and were regarded by Dr. Hayden as probably on a parallel with the lowest portion of No. 1 of his section of the Cretaceous rocks of Nebraska, though he suspected from the presence of a *Hettangia* that they might be older.

From the crossing of Sulphur Creek these strata, forming a ridge in the direction of their trend, extend southwest to the East Fork of Bear River, striking it about 1.5 miles below Captain Simpson's road, where the coal must again crop out. They also continue in the opposite direction, forming considerable mountains north of Sulphur Creek, when their trend changes more to north and finally to north-northwest, and they strike Bear River a second time near the mouth of Yellow Creek. In consequence of another disturbance, they crop out again east from there on Muddy Creek below the crossing of the Salt Lake road, where Colonel Frémont found the coal. Captain Simpson discovered it also on White Clay Creek, below the mouth of Porter's Fork, where I observed again, in connection with it, heavy beds of white sandstone with the same *Ostrea*. The latter occur likewise on Weber River, about 1.5 miles above the mouth of White Clay Creek, and again 1 mile below the point where the road, turning westward, leaves Weber River; but I did not find there any coal with them.

Strata of a similar character are exposed at numerous other points. Nine miles west of Bear River they form the Needles, on Yellow Creek, composed of strongly-tilted white and gray, compact, siliceous sandstones, which are partly fine-grained, partly coarse-grit stones, and conglomeratic, and interstratified with mostly reddish shaly strata, arenaceous shales, and shaly sandstones. Most prominent there, is a heavy mass of light-colored conglomerate, composed of rounded siliceous pebbles of the size of hen's and pigeon's eggs with only a few larger ones, thickly disseminated, together with gravel, in a mortar-like matrix. It forms the rugged crest of the hills from which they have received their name. This elevation trends toward the head of White Clay Creek, on which the same rocks were observed near the upper forks, also standing on the edge and partly even tilted beyond the vertical. The dip of the strata along that creek is not uniform, and the slopes are partly covered, so that I was prevented from obtaining a section; but as the dip generally varies between southwest and west we may presume that we come to higher strata the farther we descend the creek, and that those at the upper fork and at the Needles probably correspond to those on the east fork of Weber River near the point where I obtained Jurassic fossils. Some miles below the upper forks, in high mountains on the south side of the creek, yellowish conglomeratic sandstones crop out, also one of a dull reddish color, strongly dipping to west-southwest, and lower down a considerable thickness of alternations of impure whitish sandstones and light-colored argillaceous shales, conformable to the former and likewise containing conglomeratic seams. Near the mouth of Porter's Fork we reach the coal-bearing sandstone mentioned above, and then white sandstones, alternating with red arenaceous slate and red shales. At the lower end of the cañon, the red color predominates; but thence down I noticed again white sandstones, interstratified with gray shales, similar to those above the coal, and perhaps the same strata, because there has been a disturbance and a change of the dip, which is there generally toward west or northwest. Near the mouth of the creek these strata are capped by heavy beds of white sandstone with conglomeratic portions.

Several thick beds of conglomerates occur in this district, though mostly there are only single seams of pebbles within the beds of else rather fine-grained sandstones, not forming separate strata, which indicates that changes in the force of the currents must have taken place while the single beds were deposited. The frequent occurrence of conglomeratic masses proves, besides, that a shore-line cannot have passed far from the present Wahsatch Mountains, which existed probably before the Jurassic and Cretaceous era, although not in their present outlines. This is rendered still more likely by the absence of Jurassic and Cretaceous strata west of these mountains, as will appear from the following section V.

From the mouth of White Clay Creek to Echo Creek, a distance of 5 miles, the same formation continues, with conformable stratification and a slight dip to west and northwest, so that we advance to higher strata. Part of these are brick-red, probably forming the continuation of the red beds at the lower end of the White Clay Creek cañon. Near the mouth of Echo Cañon purple conglomerates are largely developed, and nearly horizontal. They form for some miles high vertical turreted bluffs on the north side of the cañon, while the south side generally presents steep but covered slopes, with only few exposures of rocks, which dip strongly to west-northwest. I was doubtful whether the red conglomerates were conformable; in some places they seem to be so, in others not; but I rather think that they are a local later deposit. The valley is evidently one of erosion, and not one of eruption, with anticlinal strata, as has been stated by others. Some miles farther up, white, yellowish, and dull-reddish, partly conglomeratic, and mostly purer siliceous sandstones form both sides of the cañon, probably corresponding to the lower series, which is exposed also on the upper part of White Clay Creek. Their dip is still to west-northwest, but moderate, although variable. Still higher up we find the divide capped by the sandstones, No. 3.

On Weber River, above the mouth of White Clay Creek, the same formation continues; but the uniformity of the stratification is interrupted in consequence of the proximity of the igneous rocks, which form the limits of this section, and at several points come to the water's edge. Within a short distance I observed the strata dipping to north, west, east, and northwest. From the mouth of Silver Creek to Kamas Prairie the dip is uniformly strong to northwest, and we gradually come again to lower strata, although the ridge of dioritic porphyries west of the river runs nearly north and south. This would rather indicate the pre-existence of the igneous rocks; still, other observations show conclusively that the eruption of part of them, at least, dates after the deposition of the sandstones, and at a comparatively recent period, or else we would not find their tufas, in apparently horizontal position, filling portions of the river valleys which are eroded in these stratified rocks.

Near the point where the road to the Timpanogos leaves the valley of Weber

River, I observed a layer of an impure limestone, with imperfect indications of fossils, but I did not succeed in finding a single specimen from which to identify the formation. Else, the character of the strata is unchanged.

In the northeast corner of Kamas Prairie, at the mouth of the cañon of the East Fork of Weber River, I noticed a gray, very compact, calcareous rock, and up that stream more light-red and gray compact siliceous sandstones, somewhat altered by metamorphic action, and some shaly strata. The cañon follows for a long distance, although not throughout, the trend of the strata, the dip of which varies between north and west-northwest, and is partly very strong, 60° and 70°. Some miles up that stream I found pieces of a gray altered limestone, evidently from an outcrop close by, with numerous traces of organic remains. Although I could only obtain some imperfect *Pecten*, *Ostrea*, and *Pentacrinus*, these, taken together with all the other circumstances, leave scarcely room to doubt the Jurassic age of the formation. (See Mr. Meek's report.)

The high mountains between this point and the head of White Clay Creek, which I crossed with Captain Simpson and a small reconnoitering party, are covered all over with soil, timber, and undergrowth, and therefore afford few data to the geologist. A few red escarpments were observed at a distance near the summits of the Uintah Mountains, of which more will be said below. On the summit of the trail, between Porter's Fork and the East Fork of Weber River, I observed some large masses of white granite, apparently not far out of place.

On another reconnaissance with Captain Simpson, in the summer of 1859, from Round Prairie, on the Timpanogos, to the Uintah River, I obtained a view of the continuation of the Weber River formations south of the Uintah Mountains, where they appear to be a little differently developed, with less conglomeratic portions, although the close connection between the two is evident at the first glance. The axis of the Uintah Mountains bears from east to west at a right angle to the Wahsatch Mountains, and although they may have a center of igneous rocks, and owe their origin to their eruption, these do not appear prominently in the general outlines of the chain, and besides the few blocks of granite mentioned above, I have only noticed near our trail, at their junction with the Wahsatch Mountains, some of the same dioritic porphyries which form the ridge west of Weber River. From north and south stratified rocks cover their slopes, and rise toward the summits, where they form a crest remarkable for its horizontal outlines, with deep intervening chasms and apparently high vertical walls of mostly reddish color.

Near the pass from the heads of Coal Creek, a tributary of Timpanogos River, to Potts' Creek, an affluent of Duchesne Fork of the Uintah River, the ridges are all strewn with pieces of white, highly altered, compact sand-rock, but the first stratum in place, just beyond the summit, is a siliceous conglomerate, followed by red sandstones and conglomerates, and red arenaceous and argillaceous shales, several hundred feet thick, but not well exposed. Near the summit I also obtained some imperfect fossils in a gray limestone, apparently *in situ*, which, however, could not be identified. These red strata are apparently the same which cap the Uintah Mountains farther east, and I have been doubtful whether they occupy a high or low position in the series; in other words, whether they correspond to the Lower Jurassic or Triassic formations which appear to be considerably developed farther south, or to those much more recent strata which we have observed before in the cañon of White Clay Creek, and on Weber River above Echo Creek. The observations in the field were not quite decisive on that point, and the presence of both formations may be accounted for with some degree of plausibility; but the weight of evidence is rather in favor of the more recent age of these rocks. Apparently, the same strata are prominent south from there, and at a much lower level, on the Red Fork of Uintah River, which from these has received its name.

The following is an enumeration of the strata which were observed along Potts' Creek, in descending order, and, although necessarily incomplete as a section, it shows the general character of the formation:

1. Several hundred feet of mostly red sandstones and conglomerates, and red arenaceous and argillaceous shales, with perhaps some strata of limestones. Not well exposed.
2. White, hard sand-rock, only exposed in a short outcrop.
3. Dark red friable sandstone.
4. Some gray slate, mostly argillaceous.

Farther down the creek the lower strata are better exposed, and we find:

5. A considerable thickness of mostly light reddish sandstones, but also white ones.
6. White calcareous shales and slates, and some limestones, some of which are fine-grained with an even fracture, others of an oölitic structure. They contain numerous traces of fossils. I obtained there some joints of *Pentacrinus*, and fragments of *Pecten* and *Ostrea*, which indicate that this rock belongs to the Jurassic age.
7. Light reddish quartzose, not very hard sandstones, probably several hundred feet thick. In an interstratification of finer material I observed numerous *Gasteropoda*, but their generic characters were obliterated.
8. Strata of quartzose sandstone, varying in color from white to red, and of different degrees of hardness, several hundred feet thick. At the junction of Potts' Creek and Duchesne Fork they form high precipitous bluffs, and are there mostly white and exceedingly hard, and some of them contain a large percentage of lime.

These are the lowest strata observed on this river. Continuing down Duchesne Fork we change our course more to the south and southeast, in which direction the strata dip, and we pass them, therefore, in reversed order. I observed successively Nos. 8, 7, and 6. Then followed for several miles, partly corresponding to No. 5, and, perhaps, also to the higher numbers, more loose shaly strata of mostly white color, alternations of generally arenaceous shales, and shaly sandstones, with some more prominent strata of white sandstone, which series reminded me much of some rocks on White Clay Creek and Weber River, and are most probably the same. They are succeeded by a great thickness of white and brick-red sandstones, with much less shaly portions. Where the Spanish trail comes in, we find heavy beds of white soft quartzose sandstone, with only thin intercalations of shales, some of which are red. The river here makes a bend to the east, parallel to the trend of these strata, which therefore continued for many miles along the stream, forming shelved rocky bluffs, some of which may be 300 feet high. For the last 10 miles to the mouth of Duchesne Fork the hills along the river are low, and probably correspond to the lower portion of this white sandstone series.

I have remarked above that Colonel Frémont obtained some fossils on Uintah River, some distance above Duchesne Fork, which apparently correspond to the estuary beds of Bear River, or possibly to the No. 2 of the Fort Bridger series.

The coal has not been observed here; but most likely it exists in the bluffs hidden by detritus, or else at a level not much different from that of these strata. Beds of coal occur at various points farther south, in the Wahsatch Mountains and allied ranges. I have not had an opportunity to examine any of these localities, but from all the information which I have been able to gather I have little doubt that their geological position corresponds to that of the White Clay Creek coal.

On San Pete Creek, a tributary of Sevier River, which in its upper course runs from north to south in a longitudinal valley of the Wahsatch range, several strata of coal have been discovered near the Mormon settlements of Manti and Ephraim, near latitude 39° 25′, and are worked to a limited extent. Governor Brigham Young, in a letter dated 1855, and published in the Deseret News, states in regard to them: "The upper outcropping vein is 3 feet 4 inches thick, and rests upon a stratum of rock below which is another vein from 22 to 24 inches thick, below which is a vein of beautiful coal 5 feet thick;" and the following is an extract from an official report of Brevet Lieutenant Colonel Ruggles, Fifth Infantry, to Brig. Gen. A. S. Johnston, commanding Department of Utah, of a tour of service in San Pete valley, 1859:

"About midway in the mountains bordering the valley on the west there are mines of bituminous coal of apparent considerable extent. The principal stratum is full 4 feet thick, and it crops out at an elevation of nearly 1,000 feet above the valley, and it dips west-southwest at an angle of about 20°. There were five coal strata visible, and the series is surmounted by a well-defined stratum of chalk about two feet thick."

This latter rock resembles the chalky beds of the Upper Cretaceous rocks in Northeastern Kansas. It appears that this valley is situated similarly to that of Weber River, near the geological axis of the Wahsatch range, and the limits of the district belonging to the Great Basin.

We are also credibly informed of the existence of a similar coal in the mountains east of Little Salt Lake and Cedar City; and sandstone formations, probably corresponding to those described above, occur at various localities along the road from Utah Lake to Virgin River.

Red strata, with gypsum and rock-salt, have been observed at numerous points south from our line of survey in the Wahsatch Mountains and their southern continuation. I have not examined any of them, and the red color alone would by no means be a proof of their Triassic age, less so here than in other districts, because we have seen that red sandstones and arenaceous and argillaceous shales pervade all the formations. But if we consider the large development of the Jurassic rocks, in connection with the remarks made in section III in regard to the great extent of the Triassic formation south and east, and their interstratifications of gypsum and salt, there is little room to doubt the Triassic age of these beds, unless we should consider them as Lower Jurassic.

Colonel Frémont, in his report of 1844, mentions that rock-salt is found some miles south of Uintah River. In Captain Gunnison's and Dr. Schiel's reports, red strata, with salt and gypsum, are mentioned from the neighborhood of his trail over the Wahsatch Mountains. In the report of Brevet Lieutenant Colonel Ruggles, it is stated that a stratum of rock-salt has been found in the mountains bordering San Pete Valley on the east, some 20 miles south of Manti, and that it is also represented to have been found in the mountains forming what is known as San Pete Cañon, about 50 miles from the first locality, imbedded in reddish marly clay. Some specimens of it were secured for our collection by the kindness of General A. S. Johnston and Colonel Crosman, Quartermaster-General's Department, United States Army.

From a report of Assistant Surgeon Dr. Charles Brewer, United States Army, of a march from Camp Floyd to the Virgin River in 1859, we learn that beds of gypsum are found near the mouth of Salt Creek Cañon, not far from the town of Nephi, and that red sandstones and shales were noticed at numerous points of the route.

From all these data we may safely conclude that the formation which is now generally, and with much good reason, although without unquestionable proof, referred to the Triassic era, is largely developed in the region of the Wahsatch range, south of our route.

ECONOMICAL GEOLOGY.

Agriculture.—I have spoken above of the desolate character of the Green River region. Still there are numerous points along the river and its tributaries, especially west of it, where cultivation would prove successful. A heavy growth of sage generally indicates a fertile soil, deficient in humidity, and by irrigation this want can be supplied. The lower portion of the Green River Valley, near Brown's Hole, compares in altitude with the Salt Lake region, and the climate of the two does not appear to differ much.

Higher up, toward the Wahsatch Mountains, we find more fertile valleys, like that of Black's Fork, near Fort Bridger, Fort Supply, where Mormons had settled some years ago, the head branches of Henry's Fork, and others, but their altitude above the ocean, being about 6,500 feet, is too great, and their climate, therefore, too cold. The growing season is very short, and the crops are frequently damaged by early snow-storms. Only such plants can be cultivated to advantage as require a short season for their development, and are generally adapted to a much more northern climate; and even they may occasionally be destroyed by the frequently occurring night-frosts in the middle of summer. Settlements in this part of the country will, probably, have to rely upon supplies from outside, and cultivation will scarcely be carried beyond stations put up for some special purpose other than agricultural.

Building material.—Rock, lime, material for brick and adobes, and also timber, are plentiful throughout this district, or can be procured at a moderate cost. Wood, for bridge-building, might be rafted down Green River.

Coal.—I have mentioned above that, according to Captain Stansbury, Topographical Engineers, thick beds of coal crop out south of our road, at various points on Bitter Creek, an eastern affluent of Green River, which are probably a continuation of the coal of North Platte River, which has been discussed in section III.

The Sulphur Creek coal, when fresh, is perfectly black, and has the luster of stone-coal, but it has a brown streak, and is only a superior brown coal of more recent age; weathered pieces are brown, and look much like the coal from Deer Creek (section III); it appears, however, to be of better quality. Captain Stansbury mentions it, in his report of explorations in the valley of the Great Salt Lake, as a bituminous coal, pieces of which, although much weathered, burned in a camp-fire with a bright, clear flame. I had no opportunity to obtain quite fresh pieces, as the outcrop was much covered up; but General A. S. Johnston, commanding Department of Utah, had it tried, and found it so useful for blacksmithing that he secured the locality as a military reservation. To judge from the weathered pieces, it is, however, inferior to the San Pete coal. It contains some sulphur and gypsum. It would be easy to get many thousands of bushels of this valuable material in an open quarry. The Muddy Creek coal is undoubtedly a continuation of the same beds, and the coal of White Clay Creek is, also, the same, or holds a similar position.

The coal from San Pete Valley is the best I have seen west of the Mississippi River coal-basin; but, as the pieces that I saw from there had been obtained by mining from the interior of the stratum, it cannot well be compared with the weathered pieces from Sulphur Creek. It is a bituminous, black coal, with a brown streak, and closely resembles bituminous stone-coal, and as it cokes somewhat it is well adapted to the same purposes. It contains some gypsum; otherwise no analysis has been made of our specimens. At Camp Floyd, it has been extensively used for blacksmithing, and the workmen informed me that it gives an excellent heat, but leaves much ashes, and is inferior to the bituminous coal of Pennsylvania. As this coal may be considered as occurring on the border of the Great Basin, more will be said of it in section V. If a railroad should be built across the continent in this latitude, the coal of the Wahsatch Mountains will obtain paramount importance.

Petroleum.—The spring of petroleum, near the continuation of the Sulphur Creek coal-bed, one mile from that creek, has been mentioned above, and before by Captain Stansbury. He found, in an open country, several small, shallow depressions in the ground, filled with some rain-water, and oil and tar. The fresh oil is green; by exposure it seems to be changed soon into tar of dark-brown color and aromatic taste. This tar, more hardened and somewhat mixed with soil, forms the bottom and sides of the spring. Seldom more than two or three gallons will accumulate, and I could scarcely succeed in filling one bottle with a spoon, because some people had taken it off a day or two previous. Emigrants and Mormons collect it as wagon-grease, and as a liniment for bruises, &c. By boring, I suppose, a considerable supply of the oil might be secured.

Mineral springs.—We only know of the small springs, a few miles west of Muddy Creek, on the old Salt Lake City road. Their water contains some carbonic acid and some salts, and tastes not unpleasantly. It deposits some calcareous tufa, which, at one of the springs, is colored red by a little iron.

Metallic ores were not observed, and the geological formations are such that it would be rather an exception to find any ores associated with them.

Salts.—I have, above, mentioned beds of gypsum and rock-salt, in strata of probably Triassic age; but, as part of them appear to reach beyond the limits of this section, into section V, more will be said of them hereafter.

Efflorescences of salts, on shales and slates, in the neighborhood of Green River, have also been mentioned in the foregoing.

SECTION V.

THE DISTRICT OF CENTRAL AND WESTERN UTAH (NOW WESTERN UTAH AND NEVADA).

LIMITS AND GENERAL CONFIGURATION—THE IGNEOUS ROCKS, THEIR CLASSIFICATION AND AGE—METAMORPHIC AND ALTERED ROCKS—THE STRATIFIED ROCKS—UPPER CARBONIFEROUS AND PERMIAN, LOWER CARBONIFEROUS, DEVONIAN, AND OLD RED, SILURIAN FORMATIONS—THE VALLEYS—THEIR LACUSTRINE ORIGIN—BENCHES AND WATER-MARKS—RIMS OF TUFA—THE DRAINAGE OF THE LAKES A CONSEQUENCE OF EVAPORATION—SPRINGS AND CREEKS—BRACKISH WATER—SUBTERRANEAN RESERVOIRS—HOT AND MINERAL SPRINGS—WARM SPRINGS IN ROUND PRAIRIE, IN KOBAH VALLEY, ON WALKER RIVER, &c.—IMPROVEMENTS IN THE SUPPLY OF WATER—ARTESIAN WELLS—TANKS—WELLS—SOIL AND VEGETATION—AGRICULTURE—MINERAL WEALTH—GOLD, SILVER, LEAD, IRON-ORE, NATIVE SULPHUR, SALT, GYPSUM, SULPHATE OF SODA, SULPHATE OF MAGNESIA, NATIVE ALUM, MINERAL SPRINGS, STONE-COAL, TOPAZ—GEOLOGICAL STRUCTURE OF THE SUCCESSIVE MOUNTAIN RANGES PROGRESSING FROM EAST TO WEST.

On crossing the summit of the Wahsatch Mountains, coming from the east, a section of country is entered altogether different from that on the other side. Its peculiar aspect is pre-eminently derived from a change in the geological formations, and the physical features in general. It forms a part of the region which has been called "The Great Basin," because it has no drainage to the ocean, as all the streams originating there are lost again within its limits, and which comprises all the country between the Wahsatch range to the east, the Sierra Nevada to the west, the divide of the waters of the Columbia to the north, and those of the great Colorado to the south and southeast.

The name "Great Basin," however, gives a wrong impression of its hypsometrical condition, for the profile of the country shows that its outskirts are less elevated than the central portion, which is a lofty upland, with numerous gigantic mountain ranges, equaling in height the Wahsatch Mountains and the Sierra Nevada, while in the southern portion the surrounding heights do not attain a considerable altitude. The surface, moreover, is divided into many systems of drainage, disconnected with each other.

This whole region, as far as it is known, seems to present similar features throughout, which are only modified by the varying elevation of its sections. As other portions of it have been described before, I may confine myself to a few remarks in regard to its general features along our line of travel, between latitudes 39° and 41°, from longitude 111° 25′, near Weber River, to longitude 119° 41′, in Carson Valley.

The whole must be regarded not as composed of separate mountain chains, but as one system, one great continental swell, the relief of which has been shaped by numerous parallel fissures and corresponding mountainous upheavals, running nearly north and south. Of the latter, some consist of stratified rocks, others of stratified rocks with a nucleus of igneous rocks, and still others, altogether, or nearly so, of igneous rocks. Some of them extend continuously, with a considerable elevation, over many miles to unknown distances, others fall off, and are succeeded by others, which cannot be regarded as their immediate continuation, but are rather independent ranges of similar character.

An examination of the eruptive masses leads to the conclusion that, although raised according to one system, the mountains cannot have been called into existence by one great violent effort, but that their formation has occupied a considerable period, probably with intervals of comparative rest; also, that eruptive rocks, and consequently considerable in equalities of the surface, existed long before the parallel ranges were formed.

In the single mountain chains the forces frequently did not exhibit themselves uniformly along their whole axis, but acted with locally more or less increased intensity, thus forming sporadic centers of elevation, from which spurs run out in various directions across the valleys. Such sporadic upheavals are not confined to the principal ranges, but are sometimes independently and irregularly interspersed between them. Thus the general parallelism of the ranges and valleys is not uniformly preserved, but the configuration is much modified by local irregularities.*

Afterward, this compound serrated mountain-system has been partially covered with lakes and large inland seas (some of the more southern and lower portions perhaps by the ocean). The detritus from the mountains filled the valleys partially, forming there lacustrine deposits, and producing that peculiar shape which they now present, after the water has gradually receded, from causes of which we shall speak below. Where the country was less elevated, the lakes naturally covered a large area and the waters subsided slower, burying beneath the accumulating deposits the lower portion of the mountains. In this way only the tops or crests of the mountain ranges have been left standing out like islands in a sea, forming what is now called "Lost Mountains," or "Island Mountains." In this case, then, many of the intercepting barriers became covered, and from a number of separate valleys one main valley was formed.

The disproportion between the mountain masses, alone able to retain atmospheric moisture, and the bottomless accumulations of detritus in such districts, increases the general barrenness of the country to a great extent, and makes it an absolute desert.

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*A look at the profile will enable us to account to some degree for the configuration of the surface, as I have described it above. It is well known that the whole continent has been shaped by powerful upheaving forces, which have operated on a line running mainly from north to south. Their duration may have been an extended one, perhaps beginning in the Cretaceous epoch and ending with the beginning of the present era. That corresponding depressions must have taken place in other parts of the globe, may be inferred. Now, we see from the profile that the whole area, from the Missouri River to the Wahsatch Mountains, was elevated as one solid mass, and was disrupted in a few places to the utmost, and, the western or California slope being short, the whole strain occasioned by the upheaval was concentrated on the central portion of the bubble, the basin, and only participated in in some measure by the California slope. The rocks were evidently unable to resist the strain thus created from east to west, and fissures broke open from north to south. They are not quite uniform, because the elevation continued slowly, perhaps during thousands of years, and new fissures opened at various times, wherever the solid surface resisted least, either in the line of or near the older fissures, or independent of them. It cannot surprise us that there should be some running even from east to west, although these are scarce, and not near our line of explorations. As soon as the surface split open, fluid masses from the interior burst out, forming mountains of igneous rocks, and tilted the stratified rocks, which had formed the sides of the fissure.

If we take in account also the rugged and precipitous character of its mountains, naked, or scantily covered with a growth of stunted timber, and the monotony of the expansive valleys, with their dreary sage-barrens, the picture of the country is complete.

IGNEOUS ROCKS.

We find in this district igneous rocks of various description; granite rocks, dioritic porphyries, trachytic porphyries, trachyte (?), phonolitic rocks, greenstone, basalt, pitchstone, lavas, obsidian, pumice, and numerous intermediate forms. They exhibit a close alliance with formations beyond the limits of the Great Basin, in the Sierra Nevada, the Coast ranges, the Colorado Basin, and portions of Eastern Utah.

The systematic grouping of the igneous rocks, according to their analogous composition, the different minerals which they contain as essential and accidental components, and their mode of aggregation, forms an instructive branch of geology, because all plutonic rocks formed within certain, mostly extensive, periods and limits generally bear evidence of it in their composition. They are similar to each other, and belong to the same group, the more so the nearer they approach each other geographically, originating from the same hearth. The history of the igneous rocks of a region, and their relation to the stratified rocks of the different formations, form as essential a part of the geology of a country as the history of the extinct organic life; both together only make the whole.

This department of geology has hitherto been much neglected, because no satisfactory system of classification has ever been fully established. Still, several most distinguished mineralogists and geologists have led the way in Europe, especially Prof. G. Rose, of Berlin. One of the principal obstacles to the study of the igneous rocks is the necessity of numerous and difficult analyses of the feldspathic minerals, which are of primary importance for a systematic classification. An omission in this respect led some of the most noted geologists to make different statements in regard to the composition of the rocks from one and the same locality, and, again, to use the same name for differently composed rocks.

This branch of geology seemed to require special consideration, in a country where a variety of igneous rocks predominate, but it was impossible to gather sufficient material from a hurried examination along the route, the more so because the stratified rocks all belong to a few of the older formations, and are, therefore, affected in the same way by all the more recent protrusions of igneous rocks, however different the respective age of these may be; nor have I had time and means to study the specimens sufficiently and make the necessary analyses, still less to compare them with those from other countries. From a preliminary examination of the large number of specimens, over 160, I have formed some conclusions which I give below, and which we submit for further investigation.

The granitic rocks within the limits of my observations may be readily distinguished from all other igneous rocks of the district. They are the oldest, and do not merge into any of the others. They form the bases of some of the most prominent mountain ranges. I found them in the Wahsatch Mountains, near longitude 111° 50′, and latitude 40° 27′; in the Goshoot Mountains, longitude 114° 05′, and latitude 39° 42′; in the Pe-er-re-ah range, longitude 116° 50′, and latitude 39° 30′; in the Se-day-e Mountains, longitude 117° 30′, and latitude 39° 13′; and in the Sierra Nevada, in the Carson River Cañon, longitude 120°, and latitude 39°. Rocks of granitic (?) appearance, but of doubtful character, occur also in the Mon-tim range, longitude 115°, latitude 39° 50′.

Mr. Marcou, in his report on Captain Whipple's route, near parallel 35°, although not entering much into the subject, makes distinctions in regard to the age of the granites of different ranges, and I, too, am inclined to consider some of the granitic rocks of this section as much more recent than the normal granites.* My specimens from the Sierra Nevada contain a good deal of green hornblende, besides the mica, which gives them a character not met with, to my knowledge, in the true granites of the eastern hemisphere. Similar granites have been observed by Mr. Blake, near Fort Miller, in Southern California.

The granitic rock from the Wahsatch range, east-northeast of Camp Floyd, is composed of albite, (?), quartz, and green mica, and appears to me much nearer allied to the rocks of the dioritic group, which are of more recent age.

All the other igneous rocks of the section are found merging into each other. I shall confine myself to describe some of the most characteristic ones, and point out their relation to others.

In the Wahsatch range, between the Weber and Timpanogos Rivers, we find a very instructive series of rocks, some of which have the appearance of normal trachyte, or seem to be allied to the andesite, while they probably are porphyritic diorites.†

Prof. Gustavus Rose remarks "that one might be frequently induced to group the dioritic porphyries of this continent together with the andesite which belong to the trachytic group, and is generally more recent than the diorites"; and "that the age and general development of the American dioritic rocks does not seem to differ much from that of the trachytes, while in other countries they approach more the granitic group."

My observations seem to confirm this remark, and I might be inclined to consider this series of rocks as trachytic, if the feldspar, which they contain, although similar in appearance to some varieties of the glassy feldspar, did not differ from it in the degree of fusibility. An analysis would be required to determine its mineralogical position.

I will give a description of the most characteristic specimens of this series:

No. 151 of the collection, from the summit between Silver Creek and Timpanogos River. This rock may be regarded as the most normal of these porphyritic diorites. It has a dark-gray, granular, highly quartzose matrix, which, under the microscope, is dissolved into minute crystals. It contains many small crystals of a white feldspar, also dark-brown mica, and less distinct, but very numerous throughout the matrix, slender columns of dark green hornblende.

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* The name of "granite," has, by some writers, been applied, very loosely, to all rocks of crystalline texture and more or less massive structure, of igneous as well as metamorphic origin. Systematic terminology, however, requires that this name should be confined exclusively to eruptive rocks, forming a crystalline aggregation, essentially of orthoclase, oligoclase, mica, and quartz. They form one group with the syenites, and certain analogous porphyries. They are also not known, with certainty, to have disturbed any strata younger than the Upper Carboniferous.

† Normal trachytes, according to Rose, are mainly composed of glassy feldspar and hornblende, in a feldspathic matrix, without quartz. Quartzose varieties have been separated as trachytic porphyries. Andesite is formed of oligoclase or andesine, hornblende, and brown mica, in a highly quartzose matrix. The diorites are a crystalline aggregation of oligoclase or labradorite, and greenish hornblende, or according to others of albite and hornblende, sometimes with quartz. The matrix of dioritic porphyries frequently contains mica besides these minerals.

No. 149. From the immediate neighborhood of No. 151. It is much less crystalline, more subcrystalline, and uneven on the fracture. The matrix is grayish-green (or rather a mixture of bright green, dark brown and white, the colors of the single minerals), with many minute crystals of a greenish-white feldspar, and reddish-brown columnar mica. The small crystals of the latter may, on superficial examination, be readily mistaken for hypersthene. No other minerals are crystallized out.

No. 150. From the same locality; stands between the two preceding ones.

No. 146. From the high conic mountain at the northern end of Round Prairie. The weathered surface is reddish-brown. The gray matrix, granular, and composed nearly altogether of microscopic crystals; it is thickly studded with mostly small crystals of dark-brown mica and some quartz, which is more frequent in the matrix. No hornblende is crystallized, at least not large enough to be recognized.

No. 147. Near the locality of the former. It is the same rock more completely crystallized. It contains little matrix, and besides the feldspar and quartz, and the lamellar hexagonal columns of brown mica, slender columns of greenish-black hornblende can well be distinguished.

No. 148. From the same place. It has again much more dark matrix. The crystals of feldspar are less numerous, but larger; the mica is dark-green, the matrix quartzose, and hornblende could not be distinguished.

No. 152. From the divide between Weber River and Silver Creek. It is a compact, granular, dark-gray rock, more light-colored near the weathered surface. The white feldspar and the hornblende are imperfectly crystallized. Small spots of oxide of iron indicate that more hornblende, or probably mica, has decayed. Other pieces are a little better crystallized.

No. 131. From near the same locality. It contains only little whitish matrix, and is mostly feldspar in tabular crystals, in its appearance much like some glassy feldspar or sanidine, together with many columnar crystals of dark-green hornblende, mostly thin, and a few laminæ of brown mica. This specimen has quite the appearance of a trachytic rock, but still I must consider it a diorite.

No. 153. From Weber River, below Silver Creek. It has only very little gray matrix between the coarse crystals of feldspar, the bright hexagonal laminæ of brown mica, and the grains of quartz. This rock is nearly granitic.

From the above we see that the minerals taking part in the composition of this group of rocks are: a feldspar, dark brown mica, quartz, and dark green hornblende. The latter was found only in well-crystallized specimens, and the want of one or the other of these constituents in some of the rocks must be considered as local. It seems, however, that the more the mica prevails and is well crystallized, the more does the hornblende disappear and quartz come in. This is a rule which has frequently been noticed with rocks of a much older group, the various syenites. We also see how unsafe it is to base upon one specimen, perhaps indiscriminately picked up, any conclusion on the general composition of the igneous rocks of a district, by which we might be enabled to recognize a contemporaneous formation at a distant point.

No. 132. From the hills west of Kamas Prairie. Is a dull gray, finely vesicular rock. It shows a great tendency to crystallization, containing numerous minute, indistinct crystals, of a blackish-green mineral, probably hornblende (not olivine), and some laminæ of brown mica. It may be a vesicular form of the rock No. 152, and belong to the same group, although its lavatic appearance seems to point to a more modern origin.

Rocks similar to one or the other of this series have been found in various localities—near Simpson's Spring (No. 178); in the McDowell Mountains (No. 385); in Butte Valley (No. 240); and especially in the western part of this section, in the Se-day-e Mountains (Nos. 293, 295, and 341), and near Carson River (Nos. 318, 320, 333, 334, and others). They are all composed of a feldspathic matrix, with crystals of feldspar, and either hornblende alone, or hornblende and mica, quartz and mica, or hornblende, quartz, and mica, subject to the same law of mutual substitution. Still I am not certain if all these rocks belong to the same group. The feldspar in some of them may be the glassy feldspar, sanidine, which is characteristic of the trachytic group. They would then have to be called trachytes, trachytic porphyries, and trachytic lavas.

The extreme type of another class of rocks is to be found in No. 181 of the collection, a porphyritic rock from Simpson's Spring, on the eastern rim of the Great Salt Lake Desert. In its compact matrix light pink and white are mixed It contains numerous crystals of mostly dark-colored quartz, and, somewhat less prominent, but also in large quantity, crystals of light greenish feldspar, orthoclase, with highly perfect cleavage in three or four directions, and, with difficulty, fusible at the edges, before the blowpipe. I also notice many small scales of dark green mica. In some portions of the rock pink prevails, and in others a light greenish-yellow, without any red; but in all the varieties the crystals of quartz are most prominent. This porphyry, if observed alone, might readily be considered as one of the old porphyries, allied and coeval with the granitic group; but I find in the collection a series of specimens which show that it is allied to rocks of a much more modern appearance, and prove, beyond doubt, its close connection with the trachytic porphyries. The feldspar of the other rocks belonging to that group exhibits a more glassy fracture, and a cleavage which is not so perfect in all directions. Most similar to it is the porphyry from Good Indian Spring, in the McDowell Mountains (No. 382), and specimens from Eagle Valley and Carson River, near the Sierra Nevada (Nos. 326, 316, &c.). Allied rocks were frequently met with. The quartz in many of them is highly brittle and perfectly crystallized in hexagonal double pyramids. Others show a certain want of cohesion, which is uncommon with older rocks. This group was found merging, by intermediate forms, as well into the preceding series, as also into others described below, so much so that the position of single specimens becomes doubtful.

Another extreme type is represented by specimen No. 222, from the Ungo-we-ah range. It is a porphyry, with a fine, chocolate-colored matrix and even fracture, inclosing numerous small crystallizations of white feldspar, besides which only minute black particles, probably of hornblende, could be distinguished.

Similar rocks have been found largely developed in many of the mountain-ranges.

The exact nature of the feldspathic mineral could not be determined; it does not seem to be orthoclase or sanidine; perhaps it may be albite. In their general appearance they approach nearest the dioritic porphyries. They do not generally contain quartz or mica, though exceptions are occasionally found, and thus, as well as by close geographical proximity, they merge into the other rocks of the district, especially in those described last.

Most of the rocks of adjoining districts, sometimes described as trap porphyries, must probably be referred to these two groups.

Besides these principal eruptive formations, we find numerous rocks of the pitchstone family, mostly filling veins or forming, at least, other evidently later effusions. Their color is brown or black, with a resinous or semi-vitreous luster. They are generally brittle, and contain water as an essential component; when heated they intumesce and smell fetid. Part of them contain crystallizations of feldspar, probably also zeolitic minerals.

Various other rocks were found, more subordinate and confined to only a few localities, viz, basalt, phonolite, greenstone, pumice, obsidian, and others. They will be described in a subjoined enumeration of the single mountain ranges. Of these rocks, the basaltic, at least if they really should be such, belong to a group entirely distinct from those mentioned before.

Such rocks, which we are used to consider as the products of acting volcanoes—pumice and scoria, have also been formed long before the present era. According to Mr. Blake, pumice, scoria, and charcoal occur imbedded in the Miocene Tertiary strata of California. Therefore their presence cannot be regarded as a conclusive evidence of recent volcanic action, though such may in reality have taken place.

The apparently complete want of distinct limits between these groups of rocks, essentially differing in their extreme types, and their merging by intermediate forms, by steps more gradual than are frequently found with rocks of the same group and locality, has also been observed by Mr. Th. Antisell, in the Sierra Nevada and the Coast Ranges (Pacific Railroad Report, vol. vii). It leads to the conclusion that the subterranean agencies must have been operating during a greatly prolonged period, with intervals not protracted enough to allow a material change in the condition of their hearth. The mineralogical character of the rocks seems to indicate that their formation began prior to the Tertiary period, and continued to the present era. This inference is corroborated by evidences drawn from the relative dislocations of the strata of the western continent. Single portions of the Coast Ranges of California and the Sierra Nevada have undoubtedly been raised at different periods (not considering the first upheaval of the Sierra Nevada by the granitic eruptions). The subdivisions of the Tertiary formation hold there different relative positions at different points, besides being raised, at least partly, from 2,000 to 3,000 feet above their original level. The great dislocations of the strata in and east of the Rocky Mountains also prove that such disturbances have taken place at various times prior, during, and after the Tertiary period; and they seem to have reached their climax in the eruption of these various rocks.

By further investigation we would, probably, be enabled to draw more distinct lines of separation between the different groups, and assign to them their relative age.

METAMORPHIC AND ALTERED ROCKS.

Metamorphic rocks, such as gneiss, mica schist, clay-slate, and others, are but sparingly distributed over this section, and seem to be mostly confined to the immediate proximity to the granites. They occur in the Wahsatch range, the Goshoot Mountains, the Montim range, the Black Mountains near Carson River, &c.; but only in the Sierra Nevada they are more considerably developed. The stratified rocks all over the district have, however, undergone great changes by the influence of the igneous eruptions, either directly, by mechanical force and heat, or by chemical agencies accidentally connected with the outbursts, such as alkaline waters, &c. They have been tilted, and brecciated, and baked; secretions of siliceous matter have been produced, and agate and jasper formed. In numerous places sandstones have been altered into compact flint rock; in others, they have assumed a porphyritic appearance, in consequence of a beginning secretion of crystalline quartz from the siliceous matrix, which has attained a uniform, even texture. I only mention specimens No. 273, from Kobah Valley, and No. 288, from Reese's River.

In slaty rocks such a change cannot be easily traced, because, by being similarly affected, they at once assume the aspect of truly eruptive rocks; and an appearance of stratification cannot be regarded as conclusive evidence of the sedimentary origin. It may be the result of the peculiar circumstances under which a fluid mass has cooled, or of successive volcanic effusions. I have observed several instances where igneous rocks formed what appeared to be regular diversified strata, one above the other, requiring a careful examination to convince me that the rocks were not originally aqueous sediments, and altered or semifused, but truly eruptive. In other instances the distinctions are less obvious. Igneous rocks in such thin strata, like those in veins, generally exhibit a different appearance from those in larger bodies, because they have cooled quicker in contact with cold surfaces, whereby the free play of the molecular attraction and the separation of the constituent minerals is impaired or even forced into a different direction. Instances of that kind will be mentioned in the description of the single ranges of mountains.

In the deserts east of Carson Lake I have observed a mountain of white dolomite, apparently altered from a dark-gray magnesian limestone, which still forms part of the mountain in an unaltered state. For a full description, see below.

STRATIFIED ROCKS.

Little has been known before of the formations in Western Utah, not even along the traveled routes. On the geological map of Professor Hall, in the Report on the Mexican Boundary Survey, a large portion of it is colored as metamorphic, and the remainder is left blank. In Captain Beckwith's report merely "limestones" are mentioned occasionally, but their age had not been determined. That Upper Carboniferous limestones occurred near Salt Lake, was the only fact satisfactorily established. From our investigations in the field and our collections, much important information has been derived. They have largely contributed to our knowledge of the extent and development of the geological formations, and have also proved the existence of some not hitherto known so far West. Referring to Mr. Meek's report, I will confine myself to some general remarks, and describe the rocks more fully in the subjoined enumeration of the single mountain ranges.

Stratified rocks of the Paleozoic age were found extensively developed many hundreds of feet in thickness. A large portion of them belong to the Upper Carboniferous formation, the existence of which near Salt Lake had been proved by Prof. I. Hall, from collections brought in by Captain Stansbury and others. It is principally composed of dark gray and bluish siliceous or silico-argillaceous limestones, with siliceous or calcareous slates, and some siliceous or calcareous sandstones.

With this series of rocks, as exposed in the Timpanogos Cañon, west of Lake Utah, I found fragments of *Lepidodendron* in a slate rock, and in the same mountains also a series of bluish-black argillaceous shales, containing a great deal of carbonaceous matter. Captain Simpson obtained there some pieces which are a mixture of such shale with small particles of brittle anthracite. From this we infer that the waters there at one time must have been shallow, and dry land probably near, and that conditions must have prevailed favoring the growth of coal-plants, although, perhaps, not sufficient to produce strata of coal. Examining the shales at several points, I found the carbonaceous matter only disseminated in small particles, but in other places it may be more frequent, and concentrated in pockets, and even strata of coal.

As the indications of coal of true Carboniferous date are more favorable there than at any other point examined in the far West, they ought to be followed up. The question whether stone-coal of the Carboniferous age exists here is of superior importance at the present time, when the communication by rail with the Pacific States has become a political necessity. Even if a railroad should not be located in that immediate vicinity, a thorough investigation of the subject would be desirable. If coal was found in one place, geologists would be enabled to trace it to distant points, even where it is now concealed by overlying formations or recent deposits.

In San Pete Valley, about one degree of latitude farther south, in the same mountain range, a coal has been found superior to any which I have seen west of the Mississippi coal-basin, and which would furnish a most valuable fuel for locomotives. I have not examined the locality myself. It might perhaps be a true stone-coal, and be connected with the above shales; but from all that I have been able to learn about the formation, I am confident that it is an equivalent of the Sulphur Creek coal of more recent origin, and associated with the rocks which are developed on the eastern slope of the Wahsatch range. (See section IV.)*

The Upper Carboniferous strata, wherever observed before in the western portion of the continent, seem to have been formed at the bottom of a deep ocean, which precludes the formation of coal.† Prof. I. Hall, in his Report of the Geological Survey of Iowa, vol. i, part i, p. 138, and also in the Report of the Mexican Boundary Survey, vol. i, makes use of the following language: "The conditions favorable for the production of an extensive deposit of marine limestone are not such as usually accompany the production of coal. * * * The evidences of the existence of this ocean in the far West and Southwest during the coal-period amount to almost a proof that the conditions of that area, which now constitutes a part of this continent, were never such as to admit of the production of coal-plants, and the deposition of such materials as make up the Coal-Measures, at least during the latter part of the Coal-Period. In regard to the earlier part of that period, or the time in which the Lower Coal-Measures were formed, we have not at present the means of fully deciding what were the conditions of the central or southwestern part of the continent."

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* This opinion has since proved correct.

† Mr. Blake, in a paper read before the American Association, has stated the existence of coal-plants in the south-eastern portion of the Rocky Mountains, but the proceedings have not yet been published.

On the other hand, no decidedly Lower Carboniferous strata have ever been found in those regions before, and we have, therefore, been unable to speak with certainty about the non-existence of stone-coal in the western Coal-Measures, the lower portion of which, the equivalent of the coal-bearing rocks of the Mississippi Valley, might have escaped observation in the far West. Not far from the locality of the shales, I have found Lower Carboniferous strata, and the supposition is obvious that these shales might hold an intermediate position as lower members of the Upper Carboniferous or Coal-Measure series. I have not been able to obtain a section, nor to trace the Upper and Lower Carboniferous strata to their line of connection, and, therefore, cannot express a definite opinion in this respect. The shales certainly hold a position not very high in the series, but I doubt whether they correspond to any particular horizon in the Upper Carboniferous rocks of the East.

The upper division of the rocks on Timpanogos River, consisting mostly of light-colored sandstones, some siliceous limestones, and a few red, shaly strata, is characterized by some fossils, which Mr. Meek finds analogous to Permian forms. The difference of their lithological character from that of the Upper Carboniferious rocks lower down in the cañon, favors the supposition that they are distinct from them and actually of Permian age, but the evidence is not conclusive.

Our collection contains fossils which point decidedly to the Lower Carboniferous period as the age of a series of rocks in the immediate vicinity of Camp Floyd, west of Lake Utah. These rocks are also dark-colored, impure limestones, slates, and sandstones. Part of them are much like some of the rocks in the Timpanogos Cañon, while others are much more siliceous, and the fossils are also converted into silex and badly preserved. Among them occurs the spiral axis of an *Archimedes*, a decidedly Lower Carboniferous type, and the first specimen of this fossil yet found in the region of the Rocky Mountains. At many other points strata have been observed, to which we attribute the same age.

Further west, between longitude 115° and 115° 30′, and latitude 40° 10′ and 39° 20′, there is a series of hills and mountains, trending nearly north and south, also made up of rocks of the Carboniferous age, but of a very different lithological appearance. They are several hundred feet in thickness; mostly light-yellowish, more or less arenaceous and argillaceous limestones, with an earthy fracture, also light gray, subcrystalline, siliceous limestones, and a great deal of light-yellowish, arenaceous, and calcareous slates.

The limestones are highly fossiliferous, and the greatest portion of them undoubtedly Upper Carboniferous; but other strata from the outskirts of this formation, not, however, much differing in appearance, are considered by Mr. Meek as perhaps Lower Carboniferous. Distinct limits could not be drawn.

Devonian strata have also been found at several points, and as far west as longitude 115° 58′, and latitude 39° 53′; that is, 1,200 miles farther westward than they have hitherto been found *in situ*, as far as it is known to us. We have good reason to believe that they exist also at an intermediate point in the Medicine Bow Mountains or their neighborhood. (See section III.)

The Devonian rocks are also blue limestones and slates, and do not differ essentially in their lithological character from rocks of the Carboniferous formation. A considerable development of siliceous conglomerates and sandstones, found at a higher level than the Devonian rocks, apparently occupy the position of the Old Red of the English geologists.

As yet we have no conclusive evidence of the existence of Silurian strata in this district; but there is a considerable development of magnesian and siliceous limestones, which circumstantial evidence leads me to consider as belonging to that formation. They contain only a few fossils. Some fragments of *trochiform* univalves, and some coralline forms found in them, do not afford a sufficient criterion, but are not unlike some from Silurian strata of the Mississippi Valley.

West of 116° of longitude these stratified rocks nearly disappear. Indications of them have been found at various points beyond; but they are so thoroughly altered by the influence of the igneous rocks, that no traces of fossils could be found; nor could I decide whether they are altered beds of the Paleozoic formations, or perhaps of a more distant age.

No strata of a period more recent than the Paleozoic have been found in the mountain ranges, along our line of exploration, with the exception of some quite recent formations. If they have ever been formed they must have been swept away entirely. Information communicated by Dr. Charles Brewer, United States Army, seems, however, to indicate that more recent, perhaps Triassic or Cretaceous, strata extend into the basin from the east, across the southern continuation of the Wahsatch range.

No marine Tertiary strata have been observed like those which occur in the southern lower portion of the basin. All the more recent deposits in the valleys are evidently lacustrine and local.

By the numerous pluto-volcanic eruptions the stratified rocks have been much disturbed. In the single mountains they are tilted in every possible direction and degree. Their dip is frequently reversed several times within short distances, and great contortions and faults must have been occasioned. Moreover they exhibit a great sameness in appearance throughout, and are generally badly accessible, and only at long intervals. No section could be obtained under these circumstances. The thickness of these Paleozoic strata, however, is very considerable. Hundreds of feet have been observed of each one of the formations mentioned above, and the whole must be measured by thousands.

THE VALLEYS AND THEIR LACUSTRINE FORMATIONS.

The extensive valleys occupy about half the area of the whole district. Besides some outliers of the igneous and older stratified rocks of the mountains, we find in them indurated strata only at a few points, and these are mostly stratified horizontally, and of evidently lacustrine origin. They impart no peculiar character to the valleys, most of which have derived their configuration from lakes and inland seas, which must have covered a large portion of this country within the present era, after the last great geological changes had taken place, and the continent had attained its present outlines. The valleys are generally formed by corresponding slopes, steeper near the mountains, and so gradually converging toward a center, that it would frequently require instrumental observations to decide whether the ground is horizontal or inclined. In some places we find wide flats many miles in extent. Part of these valleys are not immediately connected with water-courses, but form separate basins, and, when of considerable length, they are subdivided by a rising ground into a number of smaller ones. Others have a regular descent in their longitudinal direction, and a drainage on the surface, sending large volumes of water to lower points, especially during the season of melting snow, while later in the season most of the creeks dry up entirely.

Besides their general shape we have other numerous evidences that large bodies of water occupied the valley at a former period. At some points, as stated above, we find horizontal strata. No fossils have been noticed in them, but their petrographical character clearly indicates a recent origin. Such strata, for instance, were found in Kobah Valley, where it is interesting to observe how the drainage toward Pah-hun-nu-pe Valley was finally effected by the erosion of Swallow Cañon. In many of the valleys regular "benches" of shingle and detritus have been formed along the surrounding heights, and around the Island Mountains, indicating a former beach, sometimes of considerable width. They frequently appear as distinct water-marks of equal height all around. A striking evidence of this kind is found in the Salt Lake Valley, where such a bench-mark can be seen at a glance, extending continuously nearly 20 miles, and more than 200 feet above the present level of the lake, while others are lower down. Captain Stansbury mentions a place at the northern end of Salt Lake where he counted 13 such successive benches, the highest 200 feet above the valley, and he states that the water-marks extend to near the summit of Frémont's Island, which is from 800 to 900 feet high. Less distinct, but still easily recognizable, such benches were observed in most of the valleys, though not in so large number.

Instead of benches, we find at some points a continuous rim of calcareous tufa along the mountains, also proving conclusively a higher state of water at a former period. This was observed especially on a branch of the Great Salt Lake Desert near the Fish Springs, and in the neighborhood of Carson Lake. Such formations may also exist unnoticed in many corresponding localities. They can be readily distinguished from the tufaceous deposits of springs, as noticed at other points of the route. Interesting deposits of this kind and on a more extensive scale have been described by Mr. Blake from the Colorado Desert, in Lieutenant Williamson's Report of the Pacific Railroad Explorations.

The material composing the bottom of the valleys, although differing according to local circumstances, is generally such as cannot well have been formed in any other way than as the slowly increasing deposit of a quiet water. Except in the immediate vicinity of the mountains, where coarser fragments of rocks are mixed with it, it consists of very fine sand or clay, and is mostly an areno-argillaceous impalpable material of light buff-color. Near Camp Floyd, in Cedar Valley, where I had an opportunity to examine more closely, the upper stratum and soil is a finely arenaceous loam; the subsoil very rough, and still more sandy, and exceedingly hard when dry. They make excellent "adobes" or sundried brick, the usual building material of the country. Lower down it changes into nearly pure, very fine sand, with only a few particles of clay. This, when dry, does not appear sandy, but forms compact pieces which readily absorb water and thereby become plastic, though only slightly coherent; a little more water causes it to dissolve into single grains of sand. In such beds, from a depth of 40 feet, we obtained a number of minute fresh-water and land shells belonging to the genera *Spherium* (*Cyclas*), *Lymnea, Helix, Amnicola,* &c. Near Camp Floyd, so-called saleratus-clay is found (saleratus is an expression frequently used in that region instead of salt, the latter name being reserved for the common salt, the chloride of sodium), a bluish-gray arenaceous clay, in which salts form white crystallizations, films and nodules, mostly consisting of sulphate of magnesia, and a little sulphate of lime and common salt, perhaps also sulphate of alumina combined with the sulphate of magnesia to alum. (See below.) Similar clays are widely distributed. Also coarser sand occurs, in some places like a regular beach; in others, again, as drift-sand or deep, coarse sandy soil.

It would be superfluous to enumerate all the single observations which confirm the theory of the prevailing lacustrine formation of the basin. That the country adjoining Salt Lake and Carson Lake has once been covered with water must strike every observer. Captain Stansbury, in speaking of the Salt Lake Desert, remarks: "These plains are but little elevated above the present level of the lake, and have, beyond question, at one time formed part of it. An elevation of but a few feet above the present level of the lake would flood this entire flat to a great distance, thus forming a vast inland sea." If a rise of the water of a few feet would have such an effect, what would not be the effect of an increase of several hundred feet to the highest water-marks?

We can entertain no doubt that such was the condition of the country at the beginning of the present era, after the last great geological changes had taken place. The position of the latest Tertiary strata, capping the highest summits of the adjoining Wahsatch Mountains, proves that great revolutions have taken place at the close of that period, while the deposits of the basin exhibit not the slightest signs of a disturbance, and occupy exactly such places as they would take, and present such features as they would assume, if those agencies were renewed which led to their formation; in other words, if the country was again covered with water.

The disappearance of the water is connected with the generally increased aridity of the southwestern portion of the territory of the United States, numerous evidences of which have been adduced by all explorers. Some have tried to explain the subsidence of the water by volcanic eruptions and consequent changes of the level; but this explanation, although it may apply to single cases, is by no means satisfactory. Volcanic eruptions would only throw the water to some other point, and not effect a decrease of its quantity; and even if one basin was thus drained, numerous others would be left. Where a region of the size of the Great Basin is concerned we must look for agencies of a more general character. Others explain the disappearance of the water by subterranean outlets. Such outlets may exist in some instances, but it is impossible to assume a subterranean outlet for every sinking creek or river, especially for those nearer to the center of the district. The sinks of all the rivers have bad water in consequence of an accumulation of salts; and the water of Salt Lake is even a concentrated brine, notwithstanding the continual affluence of large volumes of fresh water by the Jordan, Bear River, Weber River, and others. If there was an outlet, the salt water would be carried off, and the lake would become a fresh-water lake.

No such suppositions are required to explain the subsidence of the waters since the beginning of the present era. We only need to examine into the natural course of events. By applying the physical laws, we find that it is all the consequence of the geographical situation, and the topographical features of the country. Evaporation is the great agency which produces so startling effects.

We have a mountainous district with numerous lakes and vast inland seas, elevated from 4,000 to 6,000 feet above the level of the ocean, and surrounded by mountain-ranges as many thousand feet higher, beyond which, to the north, east, and southeast, mountains and elevated plains extend for many hundred miles; while on the west and southwest sides the ocean is nearer, but separated from it by a gigantic range of mountains, the summits of which tower high above the clouds. The country all around will then be well supplied with moisture; soil will be formed and covered with plants best adapted to its properties and location. At such an elevation above the ocean the air is thin, the evaporation fast. Part of the vapors will be condensed again in the same district and on the neighboring mountains, but the remainder will be carried beyond and lost irreparably, feeding rivers which run away to the far-distant oceans. The climate of the country to the north, east, and southeast is too dry, even if we make allowance for a better state of things at that time, and the ocean too distant, to make an adequate return; while, to the west and southwest, the high mountains turn off the clouds, and effectually prevent the passage to the basin of more than a very limited amount of moisture; moreover, as their eastern base is much higher than the western, they will more favor the egress than the ingress of clouds. The loss will be small at first and scarcely felt; but taking place continually through hundreds of years, the effects of it will gradually begin to show themselves. The depth of the waters will diminish inch by inch and foot by foot; the shallowest spots will become dry, but still the country around will be sufficiently supplied with moisture, and capable of sustaining, vigorously, vegetable and animal life. Such seems to have been the condition while human beings lived on this continent. Traditions point to the country around these seas as the home of powerful tribes, which afterward, as the country became more and more inhospitable, emigrated to the south. The remains of ancient towns in New Mexico and Southeastern Utah, of the origin of which, and of the time when they were inhabited, the present generation has no knowledge, seem to indicate a more prosperous condition of the country in former times. It seems also to be an established fact, that then a much more vigorous vegetation existed in some of the central portions of the continent, the remains of which are still found where now only a stunted growth of desert plants scantily cover the barren waste. Volcanic eruptions may have been the immediate cause of the desolation of single spots, but we must look to agencies affecting more equally the whole country, in order to explain the changed state of the present time.

The quantity of evaporated water decreases not in the same measure, as the shallowest places become dry, and therefore the surface of the water becomes smaller, but the quantity of condensed moisture and the humidity of the surrounding country decrease proportionally. The air becomes more dry, and the evaporation, instead of actually decreasing proportional to the surface of the sea, will rapidly increase, and the shore-lines become more and more contracted. The springs, creeks, and rivers will be reduced or discontinue altogether, and the surrounding country become barren and depopulated. Thus the present condition of the basin was produced.

In the southern, less elevated, but warmer, portion of the basin the state of things is even more unfavorable. The quantity of atmospheric precipitation there is merely nominal.

SPRINGS AND CREEKS.

In the spring the snow melts in the mountains, and also the little that is in the valleys and has not disappeared before by evaporation. The water then naturally abounds on the surface. At this time the fissures and clefts of the rocks, the reservoirs from which the springs are fed during the remainder of the year, receive their supply of moisture. Rivulets and creeks run down in every direction. Many of these sink in the absorbent sand of the valleys as soon as they reach the foot of the mountains. Others continue on even to more distant points, until they sink or join larger water-courses.

The water absorbed at one point frequently returns to the surface at a lower place, forced up by an impervious stratum of clay or by a rocky barrier, especially where a valley is contracted by projecting spurs of hills or a branch valley unites with the main valley. Often the water sinks again immediately after the barrier has been crossed, within a few yards of its rise. At other points the water regains the surface because the sand is saturated to its full extent. Thus secondary springs are formed, frequently in the shape of ponds.

At this season the valley deposits absorb a great deal of water, and become miry or overflown at numerous points. During the other seasons the affluence is smaller, many creeks and springs discontinue, and the subterranean reservoirs, formed of the sand at the bottom of the valley which has been saturated in the spring, are emptied by evaporation, and by supplying the springs and creeks with which they connect.

The creeks and rivers form either lakes, the water of which disappears by evaporation, and the surplus of it is absorbed in the wet season by the adjoining sand-flats, or they dry up gradually and sink in the thirsty sand without even forming lakes.

The aridity of the climate and consequent amount of evaporation may be judged from the fact that during our survey the difference between the dry and the wet bulb thermometer frequently indicated a nearly complete absence of moisture in the atmosphere. This was observed even on the shores of Carson Lake and in Carson Valley, at the immediate foot of the Sierra Nevada, under the shadow of its stately pines, with miles of overflowed meadow-land before us.

Most waters contain more or less impurities, from the gradual decomposition of the rocks and soils which they percolate. In consequence of their continued evaporation, impurities and salt substances have considerably accumulated in many valleys, and form efflorescences on the surface. Thus the secondary springs, which issue at low points in the valleys, are frequently impregnated with salts, and all the lakes formed by the sinks of rivers contain bad water.

The mountain springs are in some instances highly calcareous, and some of them deposit considerable tufa. Some others are brackish, containing salts from the decomposition of pyritiferous slates or from other sources. These are partly unfit for use during the dry season, while they may be sweet and palatable during spring, when they run more copiously and mixed with the waters from the melting of the snow.

Although there is a great deficiency of water in general, numerous springs are found at distances convenient for the traveler, especially in the higher portion of the country. Various causes co-operate there to afford a permanent supply. Foremost in this respect is the great elevation of several of the mountain ranges. They retain snow on their summits during a great portion of the year, which not only supplies the springs directly, but also favors the precipitation of atmospheric moisture. Near the highest mountains thunder-storms gather, and rain falls much more abundantly than in wide valleys. By their very bulk they are also enabled to retain more moisture, and thus they afford a more permanent supply than minor ranges. The numerous disruptions of the rocks afford the water access to greater depth, and by a reversion of the dip bring it back to the surface at points which would be devoid of water without. Some of the finest permanent springs on the route are thus formed on the line of contact between the stratified and igneous rocks.

The sinking of the water in the sand favors its preservation. These subterranean reservoirs are impenetrable to the heat, and the water can only evaporate slowly as it rises to the surface by the capillary action, while, if exposed to the open air, it would rapidly disappear. Without this provision not only many springs would be entirely deprived of their supply, but also a general decrease of moisture would take place. A point must be reached where the quantity of water in the basin is so small that the loss by vapors carried beyond its limits is balanced by the gain of atmospheric moisture from outside. We are unable to decide whether this point has been reached or the quantity of water is still diminishing, which is said to be the case in the Salt Lake Valley.

HOT AND MINERAL SPRINGS.

There are also numerous warm and mineral springs in Central and Western Utah, several of which have long ago attracted the attention of travelers, and have been described by Dr. Wislizenus, Colonel Frémont, Captain Stansbury, Captain Beckwith, and others, to which I refer. I only mention the Beer and Steamboat Springs on Bear River, the numerous hot-springs at the western foot of the Wahsatch Mountains, the Hot Sulphur Springs at the eastern base of the Humboldt Mountains, the Boiling Springs near Mud Lake and in the Honey Lake Valley, &c. The water in most of them contains carbonate of lime, sulphate of lime, sulphate of magnesia, some little chloride of sodium, &c. Some are strongly impregnated with sulphureted hydrogen, or free carbonic acid. In the Warm Spring and Hot Spring, near Salt Lake City, common salt is the main mineral constituent.* Several of the springs deposit considerable quantities of calcareous tufa. In some places pure cold springs issue near the boiling hot salt springs, from similar orifices.†

Such hot mineral springs can only be found upon a rocky base, because if running any distance through loose deposits, they would cool, their gases would escape, their carbonate of lime be precipitated, &c., or, in one word, they would more or less lose their thermal character. For this reason we chiefly find such springs in or near the mountains; and where any apparent exceptions occur, as in the case of the spring in Kobah Valley, an underlying rocky stratum must be suspected.

The most interesting of the mineral springs along the line of our survey are the Warm Springs, in Round Prairie, on the Timpanogos, east of Utah Lake. As they exhibit the various stages of the successive formation and discontinuation of such springs, a description of them will be instructive.

Nearly the whole portion of Round Prairie, on the northwest side of the river, is formed of horizontal strata of calcareous tufa, in some places 15 to 20 feet high from the creek, and covering an area of about four square miles. On this common plateau four smaller ones have been formed on the points where the springs have chiefly concentrated their action, and on these the numerous springs are raised, or rather have raised their openings, while a few form basins in the plateaus. Most of the springs have the shape of conical tumuli of various heights, with a circular or oval opening on the top, and an oven-shaped cavity inside, wider at the base than near the rim. Their number is very great if we count all the small ones, and the diameter of the opening varies from a few inches to about 30 feet. Most of them are now dry and filled up to some extent with soil, while others contain more or less water, which is warmer or colder proportional to the quantity of the affluent. The more the deposits of the springs have choked the supplying channels the less water can flow out during a certain time, and the more heat it will lose on the way and on the surface, while the larger and less obstructed affluent will lose less heat in proportion. The temperature of the water varies, therefore, between 80° and 109°.5 Fahrenheit. Most of the springs have no visible affluent or outlet, but the temperature of the water and rising bubbles of gas indicate an affluent, and the exit must take place through crevices in the rock, and makes the ground all around marshy. One of the most beautiful forms a basin 30 feet long, 12 feet wide, and 18 feet deep, in which the water reaches to one foot and a half below the rim. The northern group of springs is distinguished by their high conic shape with a comparatively narrow base. On the western plateau is the highest spring; its cone is about 60 feet high, 100 feet wide on the top, and 200 feet at the base; its total elevation above the Timpanogos must be about 120 to 150 feet. The opening

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[*] This salt may either come from salt-beds at a depth, or more likely it is salt water from the lake, which, by a subterraneous fissure, gains access to the hot spring and is carried up in its main channel.

[†] In such cases, evidently, the cold orifice was formerly also an opening of the deep-seated hot spring, but the connection becoming obstructed, the open upper part of the channel presented a convenient outlet for cold surface-water.

on the top of this spring is only 12 or 15 feet wide, partly covered with calcareous scum deposited over aquatic plants which float on the water, and on the top of which grass was found growing. This indicates the mode in which the spring openings have been closed up. The top of the spring sounds hollow. The water was found 10 feet deep, and 107° Fahrenheit warm; it flows freely over the rim of the cone, and disappears at the base in the pumice-like tufa which it has deposited, and in the swampy ground around. The warmest spring, of 109°.5 Fahrenheit, is one of the most southern, and forms an elliptical large mound, which evidently has had different openings at different times; now all except one are closed with tufa or filled with scum, and overgrown with a luxuriant vegetation, in consequence of the humidity and warmth. The present outlet is four feet wide and nearly filled up with calcareous scum. It will be closed probably in a short time. The water runs freely over the rim, but disappears before reaching the base of the elevation. Some gas bubbles up in all these springs; it has no smell, and seems to be carbonic acid; but after the water had been kept some time in a bottle, on opening the same a distinct smell of sulphureted hydrogen was perceptible, probably formed subsequently by the decomposition of some sulphate by organic particles. The water contains, in solution, a large amount of solid substances, chiefly carbonate of lime, carbonate of magnesia, sulphate of magnesia, also some carbonate of soda and a little chloride of sodium. I could not detect anything else with the blow-pipe. The tufa, as well the compact, granular kind, which forms horizontal layers, as the pumice-like vesicular, which is deposited by the water running over the rim of the basin and on the plants which grow in the water, is mainly carbonate of lime and carbonate of magnesia. As a curiosity, I mention that the warmth of the springs attract innumerable rattlesnakes. Their principal resort is between the large slabs of tufa at a dry and shattered spring-cone.

A great deal of tufa has been deposited also at Big Spring, northeast of Battle Creek. The water of that spring tastes somewhat like that of the Warm Springs, but is not altogether unfit for drinking.

A spring with similar tufaceous cones, but on a smaller scale, and such formations as indicate an apparently similar origin, were noticed at various points. The one in Kobah Valley particularly attracted my attention. There is an irregularly conic hill, composed of calcareous tufa, some 40 feet high and 150 feet in diameter. Several former orifices can be easily distinguished on it, but the water has forced another outlet a little farther west, where it has formed a lower mound, which is overgrown with vegetation. I could scarcely hold my hand in the water, the temperature of which must be about 120° Fahrenheit. It does not taste considerably sulphurous or salt, but sustains a peculiar vegetation of a yellow color, an *Oscillatoria*, which genus of plants also grows in the hot springs of Iceland, and which smells unmistakably of iodine. It appears that these plants, by their segregating power, have absorbed from the water this substance, upon the presence of which, even in the smallest percentage, the medical properties of some of the most effective mineral-waters are founded. The same may also occur in others of these mineral springs, but generally it can be detected only by chemical analysis.

The hot spring near the bend of Walker River has a temperature of 165° Fahrenheit at the surface. It forms a small pond, from the bottom of which the water is boiling up through several holes, accompanied by bubbles of gas, probably of carbonic acid, and steaming vigorously on the surface. There are no calcareous deposits, but the ground around the spring is covered with salt, which tastes like chloride of sodium. The water must, therefore, contain salt, which, however, does not impair its taste. The salt from this spring has shared the fate of several other salts and specimens of efflorescences of the collection; it has been dissolved in consequence of the upsetting of one of our wagons in Carson River, and we are thus unable to present an analysis of it. The vegetation near this and other similar springs is peculiar, partly on account of the saline nature of the soil, partly on account of the steaming atmosphere which surrounds it, and by which its development is forced very considerably.

Fish Spring, in a branch of the Salt Lake Desert, is similar to the last, but much less warm, so that animals drink the water freely. The springs on the west side of Pah-hun-nupe Valley, on our northern route, are slightly sulphureous.

The Alkali Springs, at the western foot of the Black Mountains, east of Carson Lake, contain a water apparently impregnated with an aggregate of the most offensive ingredients, and tardily oozing from the soil wherever a hole is dug.

IMPROVEMENTS IN THE SUPPLY OF WATER.

In regions like those of Western Utah, where the natural supply of water is limited, and not always to be found at convenient distances, the question attains a para mount importance whether the supply of water cannot be increased by artificial means. Although the greatest portion of the route explored by Captain Simpson is not deficient in this respect, still considerable improvements might be made at some points in order to increase the affluent, prevent the loss of water, and provide for the watering of a large number of animals within the shortest possible time. There are also some long stretches where the traveler would be much benefited if water could be obtained at intermediate points. In the following I will confine myself to general remarks.

From all that has been said of the formation of the valleys, of the material of which their bottom is formed, and of the structure of the mountain ranges, it will appear that in general the success of the boring of artesian wells would be doubtful, except where water is naturally abundant. We do not find in the valleys that alternation of strata, permeable and impermeable to water, which is necessary for the construction of artesian wells. They generally allow the water a free circulation in every direction, and the stratified rocks are too much disrupted to be calculated upon with any degree of certainty. Frequently we would reach igneous rocks with the borer, and then the striking even of a fissure would be merely accidental. In most instances all efforts would prove abortive, and if water was really obtained, it might be warm, or sulphureous, or saline.

In order to increase the supply, we must confine ourselves to the improvement of natural springs, or to following up the water in its subterranean course at the bottom of the valleys between the quaternary deposits and the solid rocks, and gain access to it at favorable points.

Water may be obtained where small and insufficient springs rise to the surface but sink within a short distance. In order to improve them their origin must be examined. If they can be traced to a crevice in the solid rocks, we must try to prevent all loss of water, and excavate and secure large cisterns or tanks. This could be done frequently, at an expense small compared with the great benefit derived from such a work. Where springs are rather formed by exudation from a permeable stratum, or from numerous small fissures, and the water only collects upon reaching a projecting bed of a more solid nature, we would have to consider this as the actual source, which, besides the construction of tanks, would not admit of any considerable improvements. The tanks ought to be placed so that the surplus of one would successively fill the others. The last one would be intended for the watering of the animals, and accordingly be made accessible to them. In their construction special care should be taken to keep the water cool and prevent evaporation; they ought to be provided with a heavy covering. The capacity of the tanks must be enlarged proportional to the more or less permanent flow of the spring. In some instances very large reservoirs could be formed with advantage, by throwing dams across narrow ravines. As a general thing, it is preferable to economize and preserve the supply on hand than to look for a questionable increase of the affluent, because the total quantity of water which the spring is able to furnish during a season may be limited, and a too rapid drainage would only accelerate its exhaustion.

Plentiful springs, which, however, sink within a short distance, or are shallow and easily muddied—of which there are several on the route—would only require a cleaning, and a suitable inclosure to keep off the animals, and a number of small tanks to facilitate their watering. Inclosures and troughs should also be provided where animals would be in danger of falling into the springs or of miring down while thronging round the water.

We have explained before how the water, after sinking in the arenaceous formations of the slopes and valleys, re-appears at points where its progress is intercepted by underlying strata of rocks or beds of clay, and that thus numerous springs are formed in the valleys. These may be improved by similar means.

At other points the water does not actually reach the surface, but comes so near it that it can be traced by a peculiar growth of plants, and be made available. We might, in many instances, obtain water by digging to the solid rock in ravines or washes which descend from high mountains, or in which the drainage of larger districts is concentrated. In them the affluent may be permanent, and originate from deep-seated sources, which would have formed springs unless prevented by the heavy cover of loose absorbent material, or it may be the temporary result merely of the surface drainage. Should it be permanent, and in considerable quantity, it might be made accessible by excavations and secured like the springs; if only temporary, dams could be constructed across the ravine, and thus a large supply of water, at least for a part of the year, could be retained. For experiments of this kind always a narrow point of the ravine should be selected, where the water was likely to be gathered in one stream. A constant subterranean discharge of water may occasionally be reached by shallow excavations or deeper wells at the junction of branch and main valleys, especially where projecting spurs of hills or some beds of rock or clay obstruct and contract the passage.

A plentiful affluent will mostly furnish good water, unless the strata which it percolates are charged with much salt.

We will very seldom obtain favorable results by digging at other points. I have frequently mentioned the reservoirs of water, formed by the absorbent deposits, at the bottom of many valleys, but to strike them, even from the lowest points of the valley, wells would generally attain such a depth as would make them almost useless, and the water would frequently be salt. Besides, we could only distantly guess at the configuration and greatest depressions of the rocky base, and, consequently, the most favorable location for the wells. In order to save time and money, we would in such cases recommend at least a previous examination by means of an earth-borer.

SOIL AND VEGETATION.

From what has been said above, in speaking of the valleys in general, it appears that arenaceous material constitutes a considerable portion of the soil, more or less mixed with clay. Where the former prevails, the soil naturally becomes unfit to sustain any vegetation except a peculiar desert growth; but the more it is mixed with argillaceous material, and the detritus of other rocks, the more nutriment it can afford to the plants. The igneous rocks, by their decomposition, add considerably to the fertilizing ingredients.

From this it would appear that a large portion of the soils must be well constituted for productiveness. There are, however, other causes which generally prevent the spontaneous growth of such a vegetation as we find in more favored countries, and confine the successfully cultivable areas to exceedingly narrow limits. These are chiefly to be found in the meteorological condition of the country. In some narrow mountain-gorges, where there is abundance of moisture, we find a quite luxuriant vegetation; but wherever the country opens out, it assumes the character of barrens and deserts. The growth of the valleys consists mostly of several species of *Artimisia* (sage) and allied plants, becoming more and more dwarfish, and assuming a more sterile character, where the soil is more sandy and poor. In spots which receive moisture only periodically, and have a stiff, clay soil, greasewood is the prevailing vegetation. Places which are subject to overflows, and kept moist during the greater part of the year, favor the growth of wire-grass, and other coarse swamp-grasses; more mountainous localities of this kind are covered with meadows of a tall grass resembling somewhat rye. At still more swampy points, rushes and sedge-grasses occupy the surface. Over dry, deep sandy slopes, an exceedingly nutritious grass is scattered in single bunches, bearing large sweet seeds, which are eagerly sought for by animals and Indians. For the latter, most of the grass-seeds constitute a main portion of their winter supplies. In most of the mountain-ranges, several species of the so-called mountain-grasses abound. They are highly nutritious, and come out very early in spring; and even in midwinter, after a few warm days, young green sprouts may be seen between the matted bunches of last year's growth. Being of a rather dry texture, they retain their nutritious qualities as fodder, in these arid regions, all the year round, and it is principally on them that the cattle subsist.

The growth of timber is confined to the mountain-ranges and some broken sandy slopes. The cedar prevails throughout, but, although the trunk attains a considerable diameter, it generally has the shape of a stunted shrub. A small pine, with eatable seed (*Pinus monophyllus*), accompanies the former, and occasionally the mountain-mahogany and a few other small trees or shrubs are met with. A low growth of willows occasionally borders the margin of springs. Only in the Sierra Nevada, the Wahsatch Mountains, and on the banks of Carson River, larger trees of various kinds were found.

The fall of rain is too irregularly distributed, and altogether insufficient, to sustain a better vegetation. There is no season for the development of more tender plants. The frost is immediately succeeded by drought. Therefore cultivation is confined to points where the soil is good and irrigation possible, of which the light sandy loam is particularly susceptible. Naturally these advantages are only combined in narrow strips, in some mountain valleys, at the foot of the higher ranges, or near very copious springs; districts which form but a small portion of the whole area. A few spots, only, which by the influence of constant moisture have a thoroughly decomposed soil, will bear crops without irrigation, and are in some instances exceeding fertile.

The soil and climate in the neighborhood of Salt Lake are best adapted to wheat, vegetables, and root crops; also, fruit trees, apples and peaches, thrive well. A small New Mexican variety of corn produces well, and is cultivated to a limited extent; still it is frequently killed by frost, and the crop, therefore, uncertain. I have also seen tobacco growing, but the leaves were exceedingly coarse and quite woolly; a wild species of tobacco was found at several points. Cotton has also been raised in the southern part of the Territory, but the success would appear to be very doubtful.

The elevation of the Salt Lake Valley is from 4,200 to 4,300 feet above the ocean. In mountain valleys which are more than 1,000 or 1,500 feet higher, cultivation may prove very uncertain. The late frosts and early cold and snow, common at this elevation, would confine the growing and harvesting seasons in too narrow limits. Still, with a judicious selection of crops, even there permanent settlements might flourish, which have other advantages not enjoyed by those lower down. The same may apply to most of the valleys in the more elevated, central portion of the line of our survey.

MINERAL WEALTH.

Valuable and interesting minerals occur at various points in the western and central part of the Territory of Utah. Some of them are of the highest importance.

Gold.—The route passes through the gold-fields, on the east side of the Sierra Nevada, which lately have created much excitement in California and throughout the country. Close on the road, at Chinatown, on Carson River, near longitude 119° 30′, we found a number of Chinese engaged in washing gold out of the sand, gravel, and bowlders at the mouth of Gold Cañon; among which I noticed pieces of dioritic and trachytic porphyry, and other igneous and metamorphic rocks, forming the walls of the cañon; also brown hematite and quartz. They made use of the "rocker" and "long tom," and were, generally, making from $5 to $8 a day per rocker. The gold there is a fine sand gold, apparently much alloyed, for which the traders were paying $13.50 per ounce. The finer particles must have been swept farther by the force of the current flowing from the cañon. It is evidently a recent deposit, and would at once lead to the conclusion that a larger auriferous bed must be found higher up in the cañon. In fact, a short time before we came there, gold had been discovered some seven miles above, on a branch of this cañon. The diggings there are in a rotten quartz, and paid high. As much as $155 had been made by a man in a day. This is close by the now famous Comstock lode.

Gold has also been found north and south of our route, on the upper course of Walker River, &c.

In the Black Mountains, east of Carson Lake, a quartz-vein was noticed with altered argillaceous slates, gneiss, &c., but the hurried examination did not reveal any indications of gold. We must leave it to more detailed investigations to decide whether gold occurs in the more eastern ranges of Utah. No direct indications have been observed. Still we find at some points metamorphic rocks similar to those with which the gold is frequently associated in the Sierra Nevada; and these ranges seem to have been originated by the same forces which have raised the Sierra Nevada, and to have been subject to the same agencies upon which its metallic wealth seems to depend. Moreover, Mr. Blake, in Captain Whipple's Pacific Railroad Report, mentions gold-diggings in another part of the basin, namely, the Armagosa mine, near the southern road from Salt Lake to California, not many miles beyond the sink of the Mojave River, where the gold was found in connection with calcareous spar.

Silver.—At the time of our survey nothing definite was known in regard to the existence of silver in the basin. Rumors located argentiferous veins in the southern part of Utah. Recently rich silver-ore has been found in the close vicinity of the gold-mines of Carson River, in the so-called Washoe mines, which just now create so much excitement.

Lead.—Minute particles of galena were noticed in an impure brown hematite, or a decomposed, highly ferruginous igneous rock, which crops out in the mountains northeast of Kobah Valley. It appears to be connected with a mineral vein, perhaps of argentiferous lead. Some pieces of galena (sulphuret of lead) were exhibited at Camp Floyd as coming from the vicinity. Ores of lead, and perhaps copper and silver, may exist further south.

Iron-ore has not been noticed near the road, but superior magnetic iron-ore occurs in the mountains near Cedar City, a small Mormon settlement not far from Little Salt Lake, longitude 113°, latitude 38°. An attempt was once made there to manufacture iron, but it failed. I am not aware of the particulars and the reason why, but if the increased demand for iron and its price warranted it, the experiment might be renewed, and the obstacles probably be overcome by an experienced metallurgist, notwithstanding the apparently inferior quality of the coal which is found in that neighborhood, and upon which the manufacturers would have to depend.

Native sulphur is found in the same vicinity. In the collection I have a specimen (obtained from Dr. Brewer, United States Army) which is very pure, but I have been unable to get any information in regard to the quantity and connection in which it occurs. It may be the production of extinguished volcanic action. If it could be obtained in large quantity, as I should judge from the specimen, it would be highly valuable.

Salt is found in great quantity. As the water of Salt Lake is a nearly concentrated pure brine, salt can be got there at a trifling expense. (See Captain Stansbury's Report.) Other saline lakes contain impurities from which the salt cannot be freed so easily. Some of it was observed in many springs, round which it accumulates, but there is usually too little of it to be of much importance.

Near the eastern rim of the basin, in the Wahsatch Mountains, large masses of *rock-salt* are found, partly in pure transparent crystalline pieces, partly strongly mixed with red clay, with which it is associated. The specimens in the collection have been obtained by the kindness of General A. S. Johnston and Colonel Crosman. Salt is thus found in the mountains bordering San Pete Valley on the east, some 20 miles south of the Mormon settlement of Manti (in the latitude of Sevier Lake); also in the so-called San Pete Cañon, and still further south, near Captain Gunnison's trail. I have not examined any of these localities, and can, therefore, not decide to which geological formation the salt belongs. The limited information which I have been able to obtain in regard to it, and considerations of a general geological character, seem to indicate that it belongs to those strata which, in the neighborhood of Salt Lake and Utah Lake, are confined to the eastern portion of the Wahsatch range, but seem to cross it further south toward Little Salt Lake. They have been spoken of in section IV, and may be of Triassic age.

Gypsum is found in similar connection.

Various other salts are found in large quantities.

Sulphate of soda was received by Dr. Schiel as coming from the bottom of Salt Lake. (See Captain Beckwith's Pacific Railroad Report.) A salt, probably the same, forms heavy deposits on the eastern shore of Utah Lake, near Springville. Our specimens have not yet been analyzed. It is a useful article in various manufactures, especially that of soda.

Sulphate of magnesia enters largely into the composition of many salts and saline water in that part of the country. It is formed by the decomposition of various shales.

Native alums were observed in several places. They are formed by the decomposition of metamorphic slates and other rocks, &c., which contain pyrites. Captain Stansbury mentions alum from the northern end of Salt Lake. Dr. Schiel mentions a magnesian alum. All those which I have examined are magnesian alums, in which the sulphate of magnesia replaces, in a great measure, the alkaline component, which, in the common alum, is potassa. No complete analysis has been made by us of any of these alums. I have in the collection a specimen from Tuilla Valley, obtained from Colonel Crosman, and one from the neighborhood of Little Salt Lake, by Dr. Brewer.

The saleratus-clay, which I have mentioned already, seems also to contain it in considerable quantity. A specimen of this clay from Camp Floyd is of gray color, full of white crystallizations and nodules of saline substances, and sometimes whitish throughout. It is also formed by an accumulation of salts from the decomposition of rocks in the clay. The soluble portion contains a little common salt, a great deal of sulphate of magnesia, some sulphate of lime, and a little soda. Probably the sulphate of magnesia is in connection with sulphate of alumina as magnesian alum. It makes good adobes (unburnt brick), as do the other clays of that neighborhood. The salts give this clay valuable properties as building material. Mixed with four parts of sand, it forms a superior plaster, and, stirred up in water, after the heavy part has settled down, it is advantageously used as a whitewash, because it adheres better to the wall than lime-water. This clay was extensively used in the erection of the buildings of Camp Floyd.

Mineral springs.—I have spoken of them in another place. Some of them may have strong medical properties, especially on account of the iodine, of which I have discovered indications in the hot springs of Kobah Valley, of which a description has been given above. It is not unlikely that this powerful remedy might also be found, by analysis, in others of these springs more favorably situated.

Stone-coal.—In speaking of the stratified rocks, I have mentioned that the existence of true stone-coal, of the Carboniferous formation, although possible, is still doubtful, and that those coals which are found in the Wahsatch range, in San Pete Valley, and near Little Salt Lake, are probably equivalents of the coal on Sulphur Creek, &c., on the eastern slope of that range, of which I have spoken in section IV.

As this coal is much used in the Salt Lake Valley, and on account of its geographical proximity to the Basin (the limits of which it seems to cross farther south,) I have to mention it again. The San Pete coal looks like true stone-coal, breaks in cubical fragments, has a dark-brown streak, and is bituminous. It is superior to any coal which I have seen west of the Mississippi River coal-fields, although it may be equaled by the Sulphur and White Clay Creek coal, if they are taken from the depth. It cokes to a certain degree, and can, therefore, be used for all purposes, like coking stone-coal, either fresh or as coke. In case a railroad should be built in that direction, the coal-beds in San Pete Valley or their equivalent at some other point, would probably have to furnish the motive power for several hundred miles of road.

Topaz, perfectly colorless and transparent, and of great beauty and luster, has been found in considerable quantity, loose on the surface, in Colonel Thomas's range. I did not see any in the rock, but it apparently originates from one of the trachytic porphyries in that neighborhood. Its degree of hardness is = 8. Before the blow-pipe it proved infusible, and when strongly heated it was covered with small blisters, but did not show any change of color. It exhibited the re-actions of fluorine, alumina, and silex. (No tests for other elements were made). The largest of the crystals measured scarcely one-third of an inch in the direction of the basal cleavage, which was highly perfect. The crystals were all short columnar, with various modifications, corresponding to the following crystallographic expressions, according to the system—

	Of Rose.	Of Dana.
All the crystals exhibit	$\infty c : b : a$	I
	$\infty c : b : 2a$	$i\breve{2}$
	$c : \infty b : \infty a$	O
	$4c : b : \infty a$	$4\breve{\imath}$
	$2c : b : a$	2
Most of them also	$2c : b : \infty a$	$2\breve{\imath}$
	$c : b : a$	1
	$\frac{1}{2}c : b : a$	$\frac{1}{2}$
Few only	$4c : b : a$	4
	$2c : \infty b : a$	$2\bar{\imath}$

As none of the crystals have both ends perfect, I could not ascertain whether they are hemihedrally developed, as is most common with the topaz, or have both ends alike. Its pyro-electricity was not examined, nor the polarization of light, but the crystals show very plainly the double refraction.

I will conclude this paragraph with a passage from a letter of Colonel Frémont to the National Intelligencer, dated June 13, 1854, and afterward printed by order of Congress (33d Congress, 2d session, Mis. Doc. No. 8). Colonel Frémont crossed the Wahsatch range near Paravan and Cedar City, and to these points his, perhaps a little too highly colored, observations refer: "They are what are called fertile mountains, abundant in water, wood, and grass, and fertile valleys, offering inducements to settlements. The mountains are a great store-house of materials, timber, iron, coal, which would be of indispensable use in the construction and maintainance of the (Pacific) railroad, and are solid foundations to build up the future prosperity of the rapidly increasing Utah State. Salt is abundant on the eastern border; mountains, as the Sierra de Sal, being named from it. In the ranges lying behind the Mormon settlements, among the mountains through which the line passes, are accumulated a great wealth of iron and coal, and extensive forests of heavy timber. These forests are the largest I am acquainted with in the Rocky Mountains, being in some places 20 miles in depth of continuous forest; the general growth is lofty and large, frequently over 3 feet in diameter, and sometimes reaching 5 feet, the red spruce and yellow pine predominating. At the actual southern extremity of the Mormon settlements, consisting of the two inclosed towns of Paravan and Cedar City, near to which our line passed, a coal-mine has been opened for about 80 yards, and iron-works already established. Iron here occurs in extraordinary masses, in some parts accumulated into mountains, which comb out in crests of solid iron thirty feet thick and a hundred yards long."

GEOLOGICAL STRUCTURE OF THE SUCCESSIVE MOUNTAIN RANGES.

In the Wahsatch Mountains, on crossing Weber River from the east, on the road between Fort Bridger and Camp Floyd, we enter the district which I have comprised in section V. The main body of the divide between Weber River, Silver Creek, and Timpanogos River, is composed of dioritic porphyries, which I have described under the heading of igneous rocks. Near Kansas Prairie, the rocks exhibit a more lavatic appearance, but probably belong to the same group. These igneous protrusions may be regarded as the center of the range. East of them we find more recent stratified rocks, while on the west side the mountains appear altogether composed of strata of the Paleozoic formation. On Weber River, and on the Timpanogos, above Round Prairie, conglomeratic tufas were noticed, made up of these eruptive rocks, imbedded in a finer material of the same origin. These masses have either been deposited in water, or became at least cemented and indurated by its agency.

The interesting warm springs of Round Prairie, and their formation of calcareous tufa, have been described above.

Near the north end of Round Prairie, the first stratified rocks of this section were observed, tilted by the porphyries. These are mostly light-colored, and a few reddish sandstones, a siliceous limestone, and some red, shaly strata. Their age is probably the Permian (see under stratified rocks). The sedimentary rocks continue all the way down Timpanogos Cañon. At its upper end compact siliceous and calcareous sandstones prevail, which may also belong to the Permian formation; while lower down we find more dark-gray, impure, siliceous and slaty limestones, frequently threaded with numerous veins of calcareous spar or dolomite, some of which exhibit many fossil remains, expecially *Brachiopoda;* also dark bluish-gray argillaceous, siliceous, and calcareous slates. In the lower part of the cañon, and at various points south of its entrance, bluish-black argillaceous shales are exposed, containing a great deal of carbonaceous matter, and, on their decomposed surface, crystals of gypsum and efflorescences of sulphate of magnesia. At the mouth of the cañon, again siliceous and calcareous slates predominate.

Of all these rocks I have spoken before, and stated that they all, or partly, represent the upper division of the Carboniferous formation. They present no uniform dip, but are much disturbed and contorted; here horizontal, then bent with a sharp angle, or forming vaults, or folded up so that the continuity of the overlying strata is altogether broken, then rising at once vertically from the bottom of the valley many hundred feet, they again appear horizontal higher up, and thus continue in a gigantic wedge-shaped mountain to a great altitude, as if they had never been subject to any violent actions from underneath—in reality, however, because only the horizontal portion of the strata could withstand destruction, while their bent and crushed continuations did not retain strength enough, and were eventually precipitated down and destroyed.

The cañon forms a chasm in these disrupted strata, not less than 1,500 feet deep, and presenting a picturesque scenery, while the highest summits reach to the region of nearly perpetual snow, over 4,000 feet above the mouth of the cañon. This whole thickness seems to be made up of similar strata; at least the red color which characterizes many of the more modern strata, on the eastern side of the range, was not observed on these peaks.

The Upper Carboniferous formation is developed also at other points in the western portion of the Wahsatch Mountains. Prof. I. Hall recognized it in some fossils of Captain Stansbury's collection, from the vicinity of the Great Salt Lake.

Near the mouth of Dry Creek Cañon, east of the northern end of Utah Lake, a white granitic rock forms a high mount, but I did not notice near our routes any metamorphic schists which Captain Stansbury also observed near Salt Lake. In the hills north of Cedar Valley I noticed a small knob of a similar granite, scarcely reaching the surface, the stratified rocks near which exhibit strong marks of metamorphism.

The general character of the valley of Utah Lake and Jordan River is in all respects like that of the other valleys of the basin, as described above. The mountain range between Utah Lake and Cedar Valley consists of similar strata, apparently of Carboniferous age.

In the hills a few miles west of Camp Floyd, I noticed siliceous limestones, sandstones, and siliceous slates, also shales. By their fossils they are characterized as Lower Carboniferous. (See above under Stratified Rocks.) Similar rocks occur near Old Camp Floyd, at the north end of Cedar Valley. The stratification seems to indicate that the upper portion of Mount Floyd consists of strata which are higher in the series, probably Upper Carboniferous. In this and also the next range west of Rush Valley no igneous rocks were observed, but the dip there, like in all the mountains of the district in general, is variable, and changes frequently within short distances, apparently depending upon local concentration of the subterranean forces at different points of these ranges.

Cedar Valley and Rush Valley form separate basins. The spur of hills in the latter valley also consists of rocks of the Carboniferous formation, but on the road to General Johnston's Pass, east of Meadow Creek, we pass over low outcrops of sandstones, which, although tilted at an angle of 45 degrees, present a quite modern appearance, and seem to be a local formation. Still I am doubtful in regard to their age, not having found any fossils. Near the creek I noticed a low outcrop of fine white friable sandstone, or rather scarcely indurated sand with interstratifications and irregular secretions of gray, hard, brittle, siliceous rock which looks as if it was hardened from gelatinous silex, and is apparently formed from the sand by influence of alkaline (?) water, and of modern (lacustrine) origin.

The mountains west of Rush Valley consist of limestones, &c., like the last ones. The fossils collected in the various passes are mostly corals, and seem to belong to the Lower Carboniferous period. The strata in many instances exhibit strong marks of violent dislocations and altering influences, either heat or chemical agencies. Some appear as if crushed into fragments and then recemented into a regular breccia. In Oak Pass, high exposures of an altered sandstone were noticed, of nearly porphyritic appearance.

We next enter Skull Valley, or by the more southern passes, another branch of the Great Salt Lake Desert, separated from the former only by a low sand ridge. A chemical test showed the efflorescences of salt around Willow Spring to the pure chloride of sodium.

The next range of mountains of considerable extent from north to south, is Colonel Thomas's range, of which the Granite Mountain forms the northern prolongation. In the intervening country we find some more isolated mountain masses and numerous island mountains. Southwest of Willow Spring the hills are composed of altered siliceous limestones and sandstones, with remains of *Gasteropoda*, *Brachiopoda*, Corals, and *Bryozoa*, of Carboniferous age. Further south Igneous Rocks partake in the formations. The central portion of Mount Champlin is composed of the porphyry, No. 181, of the collection, which I have mentioned above (see under Igneous Rocks), and other rocks allied to the trachytic porphyries. Near the base of these mountains I noticed also other rocks, forming dikes and smaller outcrops of perhaps later origin, also vesicular rocks of dark color. All around the mountain, partly covering the igneous rocks, partly as separate, more or less distant, island buttes, stratified rocks were observed, mostly in a highly altered state, limestones, slates, and especially a dark reddish-brown siliceous sand-rock, which at some points attains a quite porphyritic appearance. The McDowell Mountains, further southwest, with their characteristic peaks, are nearly altogether composed of eruptive rocks similar to those of Mount Champlin. They exhibit a most interesting transition among themselves, and between extreme types at other points. Some of them are closely allied to the trachytic porphyries from Carson River and Eagle Valley, on the east side of the Sierra Nevada; others can scarcely be distinguished from some of Weber River, and others again present quite a peculiar appearance. In this neighborhood the Great Salt Lake and Sevier Lake deserts connect with such a scarcely perceptible change of slope, that we are frequently at a loss to tell whether we are in the one or the other.

Colonel Thomas's range, at Pass Short-cut, is composed of stratified rocks, probably of Carboniferous age, which are tilted, as well as covered, by an overflow of a trachytic porphyry of gray color. Some strata are thereby highly altered; sandstones have attained a porphyritic appearance, by a beginning secretion of quartz in single crystals, as in a porphyry. Farther to the south, near the pass on our return trail, the igneous rocks prevail, and only a few highly-altered limestones were noticed, and some layers, in regard to which I was doubtful whether they were originally eruptive or sedimentary. One of the most common rocks there has a peculiar modern appearance, in consequence of its more loose texture. In a gray matrix it contains a great deal of transparent quartz, very brittle and partly crystallized in perfect double hexagonal pyramids, also white glassy feldspar and a little black mica. It has somewhat the appearance of trachytic lava, but is closely allied to the rocks from Mount Champlin. Other varieties have a grayish white or very light pink matrix, containing only few and small crystals of the same minerals, which makes them look vastly different; probably in consequence of a beginning decomposition, or the mode of cooling to which they have been subject, they shell off in rounded masses, forming peculiar knobs, or, if the inner part has been worn out, cavities of various size.

Next follow the House Mountains, which extend from Sevier Lake northward, and are lost in the Salt Lake desert. As far as they have come under my observation, they are entirely composed of stratified rocks, dark-colored siliceous limestones, compact sandstones, and slates. Some of them are highly altered. Only a fragment of a *Trilobite*, apparently of a Carboniferous species, was found near Chapin Spring, and the lithological character of the rocks there points to the same age. Near the north end of this chain the remarkable Fish Springs are found, and not far from them, along the foot of the mountains, horizontal strata of a white calcareous marl, in appearance much like chalk, which must have been deposited in the ancient lakes, and to the formation of which infusoriæ seem to have contributed largely. Near there, I also noticed a water-mark of calcareous tufa lining the mountain-side for a considerable distance. Highly altered stratified rocks also form the main portion, at least, of the hills between this range and the Goshoot Mountains.

The Tots-arrh or Goshoot Mountains are one of the principal ranges of great length and altitude. Their main body consists of stratified rocks, limestones of mostly bluish color, sandstones and slates, which form some of the highest peaks, among them Mount Davis. In the pass from the desert to Pleasant Valley, some fossils of Lower Carboniferous age were found, and also near our camp on the western slope. Many of the strata are strongly altered, sandstones converted into quartzite, &c. Besides, we find some metamorphic rocks, mica schists, argillaceous slate, gneiss, and even granite; but I have not seen any of the porphyritic and other more recent igneous rocks. Pleasant Valley, in this range, seems to follow the line of contact between the Carboniferous and metamorphic rocks. A conglomerate is found in the pass above Red Springs, on the eastern slope. It is mostly composed of more or less rounded pieces of limestone, imbedded in a more areno-calcareous finer matrix of light reddish color. Its age is doubtful, but as it has apparently been deposited in a depression of older rocks, after the mountains had attained their general configuration, it is probably a comparatively recent deposit. In the Goshoot Mountains a considerable quantity of moisture is precipitated and retained, feeding numerous springs, which partly sink and re-appear in the adjoining Crosman Valley, &c.

Next follows the Un-go-we-ah range, between Antelope and Steptoe Valleys, also of great altitude and extent, in which stratified Paleozoic as well as plutonic rocks were observed. On the southern road we find on the east side a great thickness of bluish gray calcareous slates and siliceous limestones, and, toward the summit, with them a calcareous conglomerate, and a trachytic porphyry allied to that from the McDowell Mountains. On the west side limestones are still more extensively developed, mostly siliceous, and of dark bluish and gray color; also slates, and some sandstones. Some of these strata are strongly altered. Near the summit of the pass some fossils were obtained, indicating the Upper Carboniferous age, while others, from the western portion of the range, seem to be Lower Carboniferous. Near the northern road, the brown dioritic porphyries form the bulk of the mountains, while the stratified rocks, bluish gray siliceous limestones, and sandstones altered into flint rock, are confined to the highest summit and part of the western slope. We noticed some interesting instances of the changed appearance of the rocks at the contact between the porphyry and stratified rocks. Near our camp, in Spring Valley, in this range, highly peculiar rocks were exposed, which seem to be the result of a later intrusion, partly pitchstones, partly others of a bluish-gray color, subvitreous and easily breaking into subcuboid fragments. They contain numerous light brown secretions of the size of a pea, with a radiating structure, in the center of which frequently a small grain of feldspar can be observed; they also contain some crystals of black mica. Higher up toward the summit I noticed a local formation of conglomeratic rocks composed of igneous material, and a high knob of porphyry, closely allied to the porphyry from Simpson's Spring at Mount Champlin.

The Mont-tim range, between Steptoe Valley and Butte Valley, is composed of some granite, more recent eruptive masses, and metamorphosed strata, but chiefly of sedimentary rocks of the Paleozoic age. Near the northern road we find, on the east side of the mountains, bluish and gray siliceous limestones threaded with veins of calcareous spar, slates, &c., petrographically much like the formations in the Timpanogos Cañon, but, as some fossils, *Trilobites* of the genera *Homalonotus* and *Proetus*, prove, of Devonian age, or perhaps Upper Silurian. The same again appear near the summit of the pass. Although this is the first point where Devonian strata were noticed, they may occur also farther east, having escaped observation on account of the similarity of their lithological character with that of Carboniferous strata and the scarcity of fossils. A considerable thickness of flint-rock and altered sandstone was exhibited in and near Egan Cañon, probably underlying the Devonian limestones, and also strata of altered slates, much like roofing-slates. On the west side of the range dioritic and trachytic porphyry prevails; also pitchstone was found, and scattered knobs of such rocks extend across Butte Valley, on the west side of which the brown porphyry is again prominent. Near the southern route the range seems to be wholly composed of very compact gray siliceous limestones, in which I found no fossils; but from their similarity to Devonian strata, farther west, I am inclined to consider them coeval. A western spur of the range between the two routes, on the southwest side of Round Valley, is evidently composed of the yellow rocks of Upper Carboniferous age (see below), of which a few doubtful traces were also noticed in the pass to Butte Valley. This valley is closed at the south end by mountains of brown dioritic porphyry, and rocks allied to the pitchstones, forming a spur of a great eruption, which has its center south of Summit Spring, in the next range, and covers a considerable area.

On the northern route the divide between Butte Valley and Long Valley is low, composed of porphyritic rocks and light-colored limestones. Part of these are light gray, siliceous, and subcrystalline, or finely crystalline; others are light-yellowish, areno-argillaceous, and have an uneven fracture. They are characterized, by a large number of fossils, as an Upper Carboniferous formation, but differ much from the other strata of that age, as developed farther east. I may refer to what has been said under the head of Stratified Rocks, and to Mr. Meek's report. West of Long Valley we find similar strata, continuing to the summit of the pass to Ruby Valley, where a blackish eruptive rock, which looks basaltic, but is perhaps allied to the greenstones, forms a considerable protrusion. On the west side, in Murry Cañon, we have again the yellow rocks, but apparently more siliceous and slaty, and less fossiliferous. Their trend and dip are variable, and I did not obtain a section, but the formation must attain a thickness, at least, of several hundred feet. The strata of the spur of hills farther north, in Ruby Valley, show the same color. A few fossils from the gray limestone of an isolated low hill near the road, more resemble Lower Carboniferous types.

On the southern route these light-gray and yellow limestones and slates form the mountains between Butte and Phelps Valleys, north of Summit Spring, south of which they are cut off by the porphyries and allied rocks. In the low divide between Phelps and Buell Valleys, and in some hills farther west, similar light-grayish and yellowish rocks crop out. Some strata there are full of joints of the columns of *Crinoidea*, and a few fossils from that point are considered by Mr. Meek as more like Lower Carboniferous forms. Although the lithological character scarcely would indicate such a division, it may perhaps exist. The presence of Devonian strata, a few miles farther west, is favorable to the supposition that these beds occupy a lower position in the Carboniferous series than those near Summit Spring.

We cross the Humboldt Mountains on the northern route, near their southern extremity, where their great elevation suddenly falls off, and minor ranges appear in their stead. In this latitude the Humboldt Mountains appear to be made up of stratified rocks from their base to the highest summits. I noticed blue and gray siliceous limestones, also flint rock, and a coarse, partly conglomeratic sandstone, perhaps identical with the one in the next range west. These rocks belong probably to the Carboniferous and older formations. Only a small outcrop of feldspathic rock was observed not far from the road. The low ranges farther south, also far beyond our southern route, are formed by the Carboniferous rocks, their yellow color indicating it plainly.

In the next mountains, on the west side of Buell Valley, we again find a considerable development of siliceous limestones and slates, of mostly bluish-gray color, characterized by their fossils as Devonian. They are overlaid in the pass by heavy masses of a coarse siliceous sandstone, and a conglomerate of rounded siliceous pebbles, mostly of a rather dark color, which seem to occupy the position of the Old Red of the English geologists, between the Devonian and Carboniferous formations. A further proof of this I found near Cho-kup's Pass. Its thickness must be considerable. I observed 300 feet of it in a single exposure. On the west side of the pass eruptive masses protrude, which seem to belong to the basaltic or phonolitic group, and are partly vesicular; other rocks close by may either be allied to them or highly altered slates. I also noticed some tufa, a sedimentary local deposit of fine fragments, or ashes, of eruptive origin. McCarthy's Creek marks the line of contact between these different rocks.

In the same range, some miles north of Cho-kup's Pass, on the eastern slope, and again on the west side of the pass, I found a few fossils in gray and bluish limestones. Mr. Meek considers them as Lower Carboniferous. The main body of the range there is composed of siliceous conglomerate, flint rock, and a strongly cemented light-colored or reddish sandstone, which formation attains a thickness of at least several hundred feet. It is most probably an equivalent of the conglomerate farther south, and "Old Red." There we have it overlying Devonian strata, here we find it in connection with Carboniferous rocks. Although the latter are found on the side of the mountain, while the sandstone forms the crest, they seem to occupy a higher geological position. The upheaving forces have exhibited a great local intensity in a direction coinciding with the central line of the ridge. The strata at numerous points stand on the edge, having been tilted up at an angle of 90°, or even more. Thus the originally lower sandstones now occupy the most elevated position in the center. No igneous rocks were noticed near the pass, but they appear to form some hills farther north.

The permanent character of some springs, and the large volume of water, in Pah-hun-nu-pe Valley seems to be, partly at least, the result of the upthrusting of these sandstones and other older strata, which hold a highly elevated position in the neighboring Humboldt and Cooper Mountains, and there, at their outcrops, take up a considerable quantity of water from the melting snows and summer rains; while it is partly due to the circumstance that this valley receives the drainage of the extensive Kobah Valley.

The rocks in Swallow Cañon, between Pah-hun-nu-pe and Kobah Valleys, are dark-gray and blue impure limestones, with numerous small veins of dolomite, also slates and flinty sandstones. They are characterized by their fossils as Devonian (see Mr. Meek's report). This cañon has apparently been eroded by the discharge of the water from Kobah Valley into the less elevated Pah-hun-nu-pe Valley. The former has thus been gradually drained of its lake, the relics of which are still found, not only as marked benches and some tufaceous strata, but as a considerable succession of horizontal layers of shaly sandstones and arenaceous shales, partly calcareous, of gray, yellowish, reddish, and white colors, which form high escarpments at the southwest foot of the island mountain north of Clay Creek, Mount Lowry.

The strata comprising this mountain and the one north from there, near Willow Creek, are mostly limestones of light-gray color, subcrystalline and very compact. Only a few imperfect fossils were noticed in them, some *trochiform* univalves, and some coralline forms, which, according to Mr. Meek, appear to be similar to Lower Silurian species from the Western States. The dip of these strata also seems to indicate that they occupy a lower geological horizon than those of Swallow Cañon, and both evidences, although not conclusive in themselves, lead me to consider these strata as most probably Silurian.

Crossing Pah-hun-nu-pe Valley on the northern road, we find on its west side cliffs of a light-gray, granular, crystalline, magnesian limestone, an agglomeration of small rhomboidal crystals of dolomite, altogether presenting the appearance of many of the Lower Silurian magnesian limestones of Missouri, especially the third magnesian limestone of Professor Swallow. This series is several hundred feet thick, and succeeded by lower strata of a similar character, but more finely crystalline and subcrystalline, like other varieties of the third magnesian limestone. They are underlaid by several hundred feet of coarse sandstones and siliceous conglomerates, which would also correspond to a sandstone in the Missouri series, and perhaps be an equivalent of the Potsdam sandstone of New York. I cannot think that this sandstone and conglomerate should correspond to those in Cho-kup's Pass of the age of the Old Red, although their appearance is similar; then the limestones would be of Carboniferous age, but they are quite unlike any I have observed in that series.

An igneous protrusion, a spur of Mount Cooper, intercepts the further regular succession of the strata. Near by some variegated and altered slates crop out. At some points farther west in Kobah Valley small exposures of similar light-colored silico-magnesian limestones were noticed.

Near the north end of Kobah Valley I found some rock resembling serpentine and other more compact basaltic (?) knobs. The mountains around the western part of Kobah Valley are composed of igneous rocks, mostly porphyries, which seem to hold a position between the dioritic and the trachytic group, and differ much among themselves; some of them present a peculiar appearance, and may be later intrusions. Others appear to be allied to the phonolites.* Only near the southwest end of the valley, again some few stratified rocks of doubtful age were observed, sandstones and altered slates, and some greenish flinty siliceous strata, which have nearly lost the marks of their sedimentary origin, by the immediate contact with the igneous protrusions.

The Pe-er-re-ah range is another of the principal chains. Near our trail it is composed of granite, more recent eruptive, and some highly altered stratified rocks. At the mouth of Simpson's Cañon flint-rock and black and variegated slates were noticed; a little farther on, white, coarse-grained granite, and some more finely-grained porphyritic varieties. At the upper end of the cañon more slates, &c., were observed, but the hills are mostly covered over, and but few rocks exposed. Near the summit I found a trachytic porphyry with a feldspathic matrix and crystals of glassy feldspar and mica, and near by other similar rocks form successive overflows or protrusions, presenting the appearance of stratification. Some of them reminded me distantly of the rocks of Spring Valley in the Un-go-we-ah range, others of the rocks in Kobah Valley, and one is allied to the pitch-stones. The summit and west side of the pass are composed of granite, and only lower down on the west side some more flint-rock occurs.

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* One specimen from Wons-in-damme (Antelope) Creek, of whitish color and tufalike appearance, resembles very closely specimens from the island of Ischia, near Naples, from the extinct volcano Epomeo, the functions of which are now discharged by Vesuvius. Those specimens are a scoriaceous lava, altered by vapors of hydrochloric acid, which escape from the crater, and have converted the lava partly into kaolin.

Where we struck Reese's River, horizontal strata of modern origin were noticed, which must have been formed as lacustrine deposits, partly conglomeratic, partly fine-grained calcareous sandstones, and arenaceous limestones. In the range west of Reese's River, porphyries are largely developed, of mostly light-reddish color, and with crystals of glassy (?) feldspar and mica, and partly of quartz. With them I found some highly altered stratified rocks, especially flint-rock, and a sandstone which had become quite porphyritic by the secretion of crystalline particles of the silex; also some black pitch-stone.

Next follows the Se-day-e range, with subordinate chains. Where it has come under my observation, its main body is nearly altogether composed of plutonic masses, granite, porphyritic rocks, pitch-stones, &c. White granite was found in the center of the range, near the head of Gibraltar Cañon. Trachytic, and, perhaps, some dioritic porphyries are most largely developed. Their color is generally pink or reddish-brown; others are whitish. Those of the latter, at the mouth of Putnam Cañon, exhibit an imperfectly columnar structure. Near the eastern foot of the mountains I noticed various rocks which have evidently erupted at a somewhat later period. There are black and brown pitch-stones, at one place forming a dike, split up by numerous fissures into tabular pieces with glazed surfaces and highly brittle inside; other masses appear as a mixture of the porphyry and pitch-stone, and similar to some lavas; and a large vein is filled with a trachyte which seems to be closely allied to the rock from Weber River, No. 153 of the collection, but contains less quartz and mica. Brown porphyry prevails on the west side, and also in the more western spurs; only in the cañons some local tufaceous sediments were observed, and on Edward Creek a flinty conglomerate and some few other ledges of metamorphosed rocks.

In the park below the Gate of Gibraltar we find extensive deposits of a mostly pure white tufa, apparently formed in a lake which has been drained by the erosion of the Middle Gate. These sediments are formed of finely comminuted trachytic rocks, pumice, &c.; and the siliceous shells of *Infusoria* may have largely contributed to it. They scarcely contain traces of lime. They are apparently identical with those observed by Dr. Newberry on the upper Pitt River, Klamath Lake, &c., and called by him infusorial marls, of which he remarks (Pacific Railroad Report, vol. vii, p. 39), that they have a striking resemblance to pulverized pumice, and have doubtless been formed of similar material. I found the same on Carson River, east of Eagle Valley, where, however, they contain a few per cent. of lime; but a similar formation from the Salt Lake Desert, near Fish Springs, is a calcareous marl.

In the Middle and Lower Gates I noticed porphyry, flint-rock, and signs of other highly altered stratified rocks. Still farther on, a prominent white mountain south of the road was found to consist of purely white subcrystalline and finely crystalline dolomite, evidently altered from a dark-gray magnesian limestone which still forms part of the mountain. The contact between the two modifications exhibits no straight line, but follows irregularly secondary fissures. The stratification is obliterated by the metamorphosis. No fossils were noticed. Close by some slates crop out, and a dike of a greenish decomposed igneous rock.

Gibraltar Creek furnishes a striking example of the repeated sinking and re-appearing of the water, modified in its qualities by the strata which it percolates. At our camping-place in the Middle Gate the water was insufficient, and tasted disagreeably of clay, while lower down it is purified again by the sand. I am confident that it would be easy not only to secure a permanent supply at that Gate, but that a much better water could be obtained, at least during the greatest part of the summer, several miles lower down, and that thus the long waterless distance to Carson Lake could be much shortened.

The Black Mountains form only a comparatively low ridge east of Carson Lake, and are composed of igneous and metamorphosed rocks. The former, as exposed on the eastern slope, are unlike any of the porphyritic rocks, and appear as local protrusions, probably of later date. On the west side, dark-colored vesicular rocks were found in considerable quantity, and above them altered clay slate, gneiss, and compact quartz forming a vein or stratum. Farther north the mountains have a stratified appearance, partly caused merely by horizontal water-marks, and the rocks are black, gray, red, scoriated, vesicular, &c.

Alkali Valley, formerly a branch of Carson Lake, is still mostly a miry salt flat, with a great deal of loose drift-sand on the surrounding beach and benches, especially on the east side.

Drift-sand also covers the greatest part of the hilly country south and west of Carson Lake, as far as the bend of Carson River. In that district rocks prevail similar to those of the Black Mountains. Near the lake we find scoriaceous vesicular outcrops of dark gray and red color and igneous origin, and, lining the hills, a great deal of calcareous tufa, in places enveloping numerous particles of the red rock, and then readily mistaken as such; also, considerable of a sedimentary rock of white color, mostly composed of pumice and other igneous material, and allied to the volcanic tufas. Rocks of the basalt or greenstone group, partly vesicular, were also observed at various points between the lake and the bend of Carson River, and along Walker River, to the exclusion of other igneous rocks, except some in the main divide between the two rivers, which are distantly related to the trachytic porphyries.* One specimen of the latter has a loose porous texture, and contains in the light-gray feldspathic matrix crystals of glassy (?) feldspar and brown mica. Others contain hornblende instead of the mica, especially higher up on Carson River, and appear more allied to those from Weber River.

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*I do not think that there are any rocks along our line of survey which can properly be called basalt. Several of the basaltic rocks in the neighborhood of Carson River and Carson Lake resemble more the lavas from Monte Somma and Vesuvius, one especially a lava which erupted as late as 1806, and presents a scoriaceous surface upon which small green crystallizations can be recognized only when the rock has begun to decompose.

Highly altered sandstone was noticed at a few points; and some rocks near the bend of Walker River, and near the hot spring in that vicinity which has been described in a former paragraph, may be either eruptive or metamorphic. Gneiss and quartz-rock were observed between Walker and Carson Rivers, not far from where we struck the latter.

Near the bend of Carson River we also find the unmistakable marks of a former lake, in numerous water-marks and the calcareous tufa on the sides of hills.

Thence up Carson River, the whole formation is plutonic. The rocks are mostly trachytic porphyries, similar to some from the McDowell Mountains, with a flesh-colored or brown feldspathic matrix, and crystals of glassy feldspar, mica, and quartz; others form a transition to the dioritic porphyries and the Weber River group, containing hornblende, mica, &c; they altogether merge into each other, and may be considered as a connecting link between the two groups. Still others are black and vesicular, and conglomeratic tufas occur likewise.

I have already mentioned Gold Cañon, and the infusorial tufas below Eagle Valley. This and Carson Valley are two of the long series of valleys which stretch along the foot of the Sierra Nevada, and in which the eye of the weary traveler is, for the first time, relieved by the aspect of green meadows and cultivated fields. The eastern slope of the Sierra Nevada, along Eagle and Carson Valleys, is mostly covered by metamorphic strata, siliceous and argillaceous slates of various description, and some siliceous conglomerate; but its main body there is composed of white granitic rocks, which were observed on the Daggett trail, in Lake Valley, and Johnston's Pass. (See under Igneous Rocks.) Carson River Cañon is chiefly cut through these white, coarse, crystalline granites. There the contrast of their precipitous, resplendent walls, split up into cuboid blocks, like cyclopean mason-work, and the green foliage, the majestic trees, and foaming mountain-torrent, form an imposing, I might say sublime, scenery not soon effaced from the memory of the beholder.

APPENDIX J.

REPORT

ON THE

PALÆONTOLOGICAL COLLECTIONS OF THE EXPEDITION.

BY

F. B. MEEK,
PALÆONTOLOGIST.

NOTE BY THE AUTHOR.—As may be seen by the date of the accompanying letter to Captain Simpson, this report was prepared as far back as 1860. So many years had, therefore, passed away without any apparent probability of its publication, that I had long since abandoned all expectation of ever seeing it published. I had, however, long back, published brief notices of the new forms collected by the expedition, in the Proceedings of the Academy of Sciences at Philadelphia, thus securing to Captain Simpson's important explorations the credit of their discovery.

After the elapse of so many years without any prospect of the publication of Captain Simpson's report, being aware how very desirable it is that figures and descriptions of all named species should be placed within the reach of palæontologists, I availed myself of the opportunity to prepare figures and descriptions of some of the same species for another report. This, of course, I should not have done, had I known that Captain Simpson's report would be published, even at this late date. The appearance of some of the same species, however, in two different reports is really not a superfluity, as the figures and descriptions appear in connection with reports of distinct explorations, and aid in the elucidation of each, while wider circulation among geologists and palæontologists, of the illustrations and descriptions, will also be secured.

In revising this report at this later date, it has, of course, become necessary to make some changes of nomenclature, &c., to bring it up to our present knowledge of the palæontology and geology of the far West. In doing this, I have tried, as far as possible, by inserting the dates of changes, and by referring to various publications that have issued since the original preparation of this report, fifteen years back, to do full justice to the subsequent labors of others, as well as to my own later publications.

F. B. M.

SMITHSONIAN INSTITUTION, *November* 8, 1875.

APPENDIX J.

REPORT ON THE PALÆONTOLOGICAL COLLECTIONS OF THE SURVEY.

By F. B. Meek.

Washington City, *D. C.*, *May* 23, 1860.

Capt. J. H. Simpson,
Topographical Engineers, U. S. A.:

Dear Sir: In the following report, on the fossils collected by Mr. Henry Engelmann, the zealous geologist of the party under your command during your late explorations in the far West, you will find figures and descriptions of such new species as are in a condition to be fully characterized. Figures are also given of a few other well-known forms, which are especially interesting in consequence of the fact that they have not hitherto been found at such remote western localities. In addition to these, the collection contains many specimens too imperfect to be satisfactorily identified with known species, or described as new, though quite a number of them are doubtless new to science.

As a large proportion of the collection is from a region of country in regard to the geology of which little is known, I have thought a full list of all the fossils brought in, with references to the localities at which they occur, would be interesting to scientific readers, as well as useful to future explorers. In making out this catalogue, where only generic names could be given, a brief description of some of the more marked characters of the species has, in several instances, been added.

The fossils contained in the collection give evidence of the existence along the line of survey of rocks belonging to the Devonian, Carboniferous, Permian, Cretaceous, Jurassic, and Tertiary epochs.* Those of Devonian age were collected in the region of Humboldt Mountains, near the middle of the Great Salt Lake Basin, at the following points: Latitude, 39° 45′ north, longitude, 114° 45′ west; latitude, 39° 33′ north, longitude, 115° 58′ west; and latitude, 39° 30′ north, longitude, 115° 36′ west.

The specimens obtained at the first of these localities are in slabs of hard dark-bluish limestone, and consist of fragments of *Trilobites* belonging apparently to the genera *Homalonotus* and *Proetus*. These may possibly be Upper Silurian species, but they have so much the appearance, so far as can be determined, of forms occurring in the Hamilton group of the New York series, that, when taken in connection with the lithological characters of the matrix, they leave a strong impression on the mind that they probably belong to about the same horizon.

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*Evidence of the existence of Triassic rocks at some places along the line of survey was also observed. It is, however, altogether of a stratigraphical and lithological character, no organic remains having been observed in these beds. (See a communication by Mr. Engelmann and the writer, Proceedings Academy Natural Science, Philadelphia, April, 1860.)

The fossils found at the other localities mentioned above are, I think, decidedly Devonian types, and also occur in dark-bluish limestone. They consist of *Atrypa aspera*, or a closely allied species, *A. reticularis*, a small *Productus*, and three or four new species of *Spirifer*. As the genus *Productus* is now generally regarded as not dating back farther than the Devonian system, and neither *Atrypa reticularis* nor *A. aspera* ranges up into the Carboniferous, while the species of *Spirifer*, as well as the small *Productus* associated with these, are all closely allied to forms characterizing the Hamilton group, the evidence is nearly or quite conclusive that the rock from which these fossils were obtained belongs to the Devonian system, and I think it will be found to be nearly on a parallel with the Hamilton group.

It is an interesting fact, in case these specimens should really prove to be of the age of the Hamilton series, that at this distant locality they should be found in beds having almost exactly the lithological characters of some of the dark calcareous portions of that formation in New York; while the fossils of the same age found in the intermediate Western States, generally occur in much lighter-colored strata.

It is worthy of note that the localities at which these specimens were obtained are near twelve hundred miles farther westward than such fossils have hitherto been found *in situ*, so far as known to the writer, within the Territory of the United States. It is true that a few fossils, consisting of some *Brachiopoda*, and others similar to *Monotis*, collected by Captain Stansbury from shaly arenaceous beds near the North Platte, three or four days' march beyond Fort Laramie, were formerly supposed to be of Devonian age;* but it is now known that the outcrop there alluded to consists of Jurassic, and probably some Triassic, strata; though the fossils were obtained from the former.

Some specimens belonging to the genera *Spirifer*, *Conocardium*, &c., collected by Mr. H. Engelmann in 1856, near Medicine Bow Butte (latitude 41°, longitude 106° 30′ west), were supposed by Dr. Shumard to be also of Devonian age, but the evidence was not regarded as conclusive, and the fossils were found in an erratic mass, the exact original position of which could not be determined.

The specimens provisionally referred to the Lower Carboniferous epoch were collected west of Lake Utah, near Camp Floyd, latitude 40° 13′ north, longitude 112° 8′ west; and at two or three localities much farther westward, near Humboldt Mountains, already referred to. Those from the first of these localities occur in a hard, compact, dark-colored siliceous limestone, which I am informed by Mr. Engelmann is rather extensively developed in that region. They are all silicified and not in a condition to show very satisfactorily their specific characters, though forms very similar to *Orthis Michilini* and *Hemipronites crenistria* occur among them. There are also, along with these, fragments of *Corals*, *Spirifer*, *Athyris*, and the spiral axis of a species of *Archimedipora*. As the last-mentioned fossil belongs to a genus common in the Lower Carboniferous, and not yet certainly known to range up into the Coal-Measures, and the forms associated with it resemble species occurring in the Lower Carboniferous series of the West, while there is an absence of any exclusively Coal-Measure types among them, the weight of evidence is in favor of the conclusion that these dark-colored limestones belong to the lower principal division of the great Carboniferous system.

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* See Captain Stansbury's Report, Great Salt Lake, page 403.

The other fossils supposed to be of the same age as those mentioned above, are in part from a similar dark-colored limestone on the west side of the south branch of Humboldt River, latitude 40° north, longitude 115° 37′ west; and from a grayish subcrystalline limestone some sixty miles in a southwest direction from the locality just mentioned. The first consist merely of imperfect specimens of *Productus* and *Spirifer*, none of which show enough of their characters to be certainly identified with known species; but, from the position of the beds in which they occur with relation to other rocks hereinafter to be noticed, they would seem to be most probably of Lower Carboniferous age.

A few imperfect specimens collected at various places along the route between Humboldt Mountains and Camp Floyd, indicate that much of the country is occupied by Carboniferous rocks, though it is not improbable Devonian and possibly Silurian deposits may be exposed at several places between these two distant localities, in addition to that already mentioned at which fragments of *Trilobites* were found.*

The specimens I have referred to the Upper Carboniferous epoch are in part from dark shaly beds in Timpanogos Cañon east of Lake Utah, latitude 42° 22′ north, longitude 111° 38′ west; and from extensive exposures of light-yellowish gray, more or less argillaceous, and arenaceous subcrystalline limestones, forming mountain chains between longitude 115° and 115° 30′ west, latitude 40° 10′ and latitude 39° 20′ north. Those from the dark shaly beds at the first of these localities consist of *Spirifer*, *Productus*, *Athyris*, and fragments of a *Lepidodendron*, none of which are known to be identical with described species, but from their general resemblance to Coal-Measure forms, and the nature of the matrix, we may infer with some degree of confidence that they belong to that epoch.

The collections from the yellowish limestone series alluded to above, contain specimens of *Chonetes*, *Productus*, *Spirifer*, *Athyris*, *Pecten*, *Nautilus*, &c., the species being for the most part new, and also distinct from those found in the dark shaly beds at Timpanogos Cañon. One of *Spirifer*, however, seems to be identical with *S. cameratus*, Morton, or closely allied to it, and one of *Athyris* is undistinguishable from *A. subtilita*, Hall (sp.); while the *Chonetes* is quite similar to *C. Verneuiliana*, Norwood & Pratten. From the presence of these Coal-Measure types, and the absence of any well-marked Lower Carboniferous species among the collections from this rock, I am led to refer it, at least provisionally, to the upper division of the Carboniferous system.

Specimens from deposits of the age of the Coal-Measures were collected from limestones on the North Platte, fifteen miles above Fort Laramie, and at several places in Eastern Kansas. The occurrence of rocks of this age at these localities is now so well known, however, as to require no especial notice here.

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* There are in the collection from localities a little west of longitude 116°, near Humboldt Mountains, some specimens of hard, compact, bluish and grayish limestones, containing small subcylindrical bodies, some of which present the appearance of small ramose sponges or corals similar to species of *Chætetes*, common in some of our Lower Silurian rocks of the Western States; though I saw none in a condition to show pores, if they exist.

As we now know of the existence of Carboniferous and Devonian formations at these distant western localities, and Silurian fossils have already been identified by Dr. Hayden and the writer from the Black Hills, Dakota, as well as from the South Pass (latitude 108° 30′ north, longitude 42° 12′ west), we may infer that nearly all the principal members of the great Paleozoic series will probably yet be found along the Rocky Mountains, and in the country between them and the Pacific.

In some masses of very hard, light-grayish, compact, silico-calcareous rock from Timpanogos River above the cañon, there are some imperfect specimens of small aviculoid shells resembling the Permian genus *Bakevellia;* also fragments of a coral similar, as far as can be determined, to the genus *Phyllopora* of King. From the analogy of these fossils to Permian forms, and the fact that the bed in which they occur holds a higher stratigraphical position, as I am informed by Mr. Engelmann, than the dark shaly deposits supposed to be of Upper Carboniferous age, farther down the river, there would appear to be some reason for thinking there may be here a representation of the Permian. This supposition would also seem to receive further support from the occurrence at localities not far east of this of Jurassic, and probably Triassic, deposits; still it would be unsafe without more reliable evidence to refer these fossils to the Permian epoch.

There are in the collection from localities in Eastern Kansas, near Cottonwood Creek, on the north side of Kansas River, several specimens of yellowish magnesian limestone, containing apparently the same species of *Pseudomonotis*, *Aviculopecten*, *Bakevellia*, *Myalina*, &c., known to occur at many places in the eastern part of that Territory, in strata that have been referred to the Permian system. As there is, however, in that region a mingling of Upper Carboniferous and Permian types, through a considerable series of beds, it is impossible to determine, from these few specimens, whether the particular outcrops from which they were obtained should be classed with the Permian or the Upper Carboniferous, though they most probably belong to the former.

The farthest western locality at which specimens were collected indicating the occurrence of Jurassic rocks is on the east side of the Wahsatch Mountains (latitude, 40° 48′ north, longitude, 111° 15′ west). They consist of gray, argillaceous, more or less sandy rock, containing fragments of *Pecten*, *Ostrea*, and stems of *Pentacrinus*, which latter agree exactly with those of *P. asteriscus*, Meek and Hayden, from the Jurassic beds at the Black Hills, Dakota. The strata containing these fossils are associated, as I am informed by Mr. Engelmann, with a series of light-colored and reddish sandstones.

At Red Buttes, on the North Platte, above Fort Laramie, well-marked Jurassic fossils were also collected, in gray argillaceous sandy beds. They consist of fragments of the same *Pentacrinus* mentioned above, and an Oyster, nearly related to *O. Marshii* and *Gryphecæa calceola*, Quenstedt, or an allied species, a new species of *Pecten*, near *P. lens** of Sowerby, and *Belemnites densus*, Meek and Hayden.

The strata from which these fossils were collected are clearly of the same age as the Jurassic outcrops at the southwest base of the Black Hills, and, as at that place, hold a position above a series of red arenaceous deposits containing large quantities of gypsum.†

A few fossils of Cretaceous age were found as far west as Bear River, and on several of the tributaries of Weber River, east of the Great Salt Lake. They occur at these localities in whitish and light-yellowish sandstones, and consist of a small *Anomia*, an Oyster like *O. glabra*, Meek and Hayden, and an *Inoceramus* similar to the western species usually referred to *I. problematicus*, Schlot. (sp.).

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* I have, since writing the above, described this species under the name *Camptonectes bellistriata*.

† No fossils have yet been found in these gypsum-bearing formations, either on the Platte or at the Black Hills, but owing to the fact that those discovered in the overlying Jurassic strata, at both of these localities, are nearly all closely allied to Liassic forms, while similar gypsum-bearing deposits are known to come in above the strata containing Permian types of fossils in Eastern Kansas, it appears possible that they may, in part, represent the New Red Sandstone of the Old World.

Deposits of good brown coal and beds of shale were also seen at some localities, associated with the strata containing the above-mentioned Cretaceous fossils, and apparently dipping at the same angle, so as to leave the impression, when the outcrops were examined, that they belong to the same series of strata containing the Cretaceous fossils.*

Cretaceous fossils were also collected from near the bridge on the North Platte, above Fort Laramie. They are *Ostrea congesta*, Conrad, two or three species of *Inoceramus*, with fragments of a small *Baculites*, and occur in gray, soft shaly beds, evidently of the age of No. 2 or 3 of the Upper Missouri Cretaceous series.

There are, likewise, in the collection a few Cretaceous fossils from near Little Sandy Creek, in Southeastern Nebraska, where rocks of that age were previously known to occur. They are in a whitish limestone matrix, evidently belonging to the horizon of the Niobrara beds, or No. 3 of the Upper Missouri section, and consist of *Inoceramus problematicus*, Schloth. and fragments of a small *Baculites*.

Quite a number of specimens in the collection from the Green River country, east of the Wahsatch range of mountains, are of Tertiary age. They evidently came from two formations, as they consist of two distinct groups of fossils, and Mr. Engelmann informs me that the more recent series seems not to be conformable in its dip with the older, which was highly inclined at the localities examined. This older series also differs from the other in being clearly an estuary or brackish-water deposit; while the newer, so far as known, contains the remains of only strictly fresh-water mollusks.

The older formation mentioned above was seen on Bear River, near the mouth of Sulphur Creek, some 30 miles west of Fort Bridger, and but a few hundred yards distant from the outcrops of brown coal and yellow sandstone with *Inoceramus* already mentioned. These beds are chiefly dark-colored and grayish, argillaceous shales, with coarse, dark and lighter-colored calcareous grits. The fossils found in them belong to the genera *Unio*, *Corbula*, *Goniobasis*, *Viviparus*, and *Rhytophorus*;† being just such an assemblage as we might expect to find in an estuary or brackish-water deposit.

The fossils from this region, figured by Professor Hall in Frémont's report, Plate III, are fresh- and brackish-water types, and possibly may be from this horizon. I have always been at a loss, however, to identify, with confidence, the species described in Frémont's report, partly on account of the brevity of the descriptions and the want of more satisfactory illustrations, but also to a great extent owing to the fact that the localities are only given by longitudes and latitudes, which were, at that time, not determined with sufficient precision to know certainly exactly from which one of several distinct formations the specimens were obtained. At one time I was rather inclined to think that the shell described by Professor Hall, in Frémont's report, under the name *Cerithium tenerum*, might be one of the Bear River species of *Goniobasis*, and two other shells described by him in the same report, under the names of *Natica? occidentalis*, and *Turbo paludinœformis*, might be the young of a *Viviparus* found at the Bear River locality, but on these points it is not possible to arrive at any very satisfactory conclusion until some one can be fortunate enough to be able to make comparisons with Professor Hall's type-specimens.

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* Since these remarks were written, I have visited this locality, and found the coal-beds there clearly included in the Cretaceous strata mentioned above. (See remarks of the writer on this subject in Hayden's Sixth Annual Report United States Geological Survey of the Territories, 1872.)

† The type of the genus *Rhytophorus* was originally ordered by me to *Melampas*.

At the time of writing this report, all of the facts known seem to favor the conclusion that the Bear River fresh-water beds belong to the Lower Tertiary.*

The still more modern series mentioned above occupies an extensive area in the Green River country. I am informed by Mr. Engelmann, that it is mainly made up of greenish sandstones and arenaceous shales, with some calcareous beds, several hundred feet in thickness, in which no organic remains were found. Beneath these beds, however, he discovered light-colored shales and limestones, containing great numbers of fossils belonging to a few species, all of which are fresh-water types. Those collected consist of two new species of *Melania*, two of *Limnea*, one of *Unio*, and three of *Planorbis*.†

In some respects a part, at least, of these deposits seem to correspond in a general way with those of the Upper Missouri; that is, they consist of an older series of brackish-water origin (probably in local isolated basins), succeeded by fresh-water formations, extending over much wider areas. It is worthy of note, however, that the fossils found in these Utah [and Wyoming] Tertiary formations are all, so far as known, specifically distinct from those characterizing the Upper Missouri beds, excepting a single species of *Viviparus* already mentioned (*V. Conradi*, Meek and Hayden), which is common to the Sulphur Creek estuary deposits,‡ and those of the Upper Missouri, near the mouth of Judith River. Still, it is probable that we have not yet obtained facts enough to be able to determine whether or not these formations correspond in their details with those of the Upper Missouri.

From what has been said, it will be seen that all the fossils contained in the collection from localities along the line of the survey, in the Great Salt Lake Basin, are from Paleozoic rocks; while all those from Secondary and Tertiary formations were collected from localities east of the Wahsatch range of mountains.§

Very respectfully, yours, &c.,

F. B. MEEK.

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* Long after the expression of this rather cautious opinion, I intimated that these beds might possibly be Upper Cretaceous rather than Lower Tertiary; but still felt the want of any positive evidence warranting this conclusion. (See Mr. King's Report Geol. Survey of the Fortieth Parallel, III, 466.) At a still later date (Hayden's Sixth Annual Report Geol. Survey of the Territories, 462, 1873), after having visited the locality, and being forcibly impressed with the fact that these brackish-water Bear River beds are upheaved nearly to a vertical posture, like the marine, decidedly Cretaceous beds at the same place, with the same strike, I was still more strongly impressed with the probability that the former also belong to the Cretaceous. It was my intention at that time to discuss this question more at length, but even before quite closing the page of my remarks in Hayden's Report, just alluded to (which was the last part of the same written), I was suddenly attacked with a severe and dangerous sickness, and merely had a brief note added, saying that "until some decidedly Cretaceous fossils have been somewhere found in or above these beds, they may be left in the Lower Eocene." The weight of evidence, however, favors the conclusion that they belong at the top of the Cretaceous (November, 1875.)

† These seem to belong in part to what has since been called the Green River group (November, 1875).

‡ These are the Bear River beds already mentioned.

§ Some of the facts and conclusions contained in the foregoing remarks were published by the writer, in connection with Mr. H. Engelmann, in the Proceed. Acad. Nat. Sci. Phila., April, 1860.

DESCRIPTIONS OF NEW SPECIES.

DEVONIAN FOSSILS.

MOLLUSCA.

BRACHIOPODA.

Genus PRODUCTUS, Sowerby.

PRODUCTUS SUBACULEATUS, Murchison (?).

Plate 1, fig. 3, *a*, *b*, *c*.

Productus subaculeatus, Murchison (1840), Bull. Soc. Geol. de Fr., XI, 255, pl. ii, fig. 9; and of numerous other later writers.

Shell small, subhemispherical; hinge scarcely equaling the greatest breadth. Ventral valve regularly convex, not produced in front; beak projecting little beyond the hinge; ears small, flattened, and nearly rectangular at their extremities; surface having scattering spines-bases, and marked by fine lines of growth and obscure concentric wrinkles, which latter become obsolete excepting near the beak and on the lateral slopes. Dorsal valve nearly semicircular, distinctly concave in the central and anterior regions, more flattened toward the cardinal border and the lateral extremities of the hinge; surface marked by small concentric wrinkles, and little scattering pits corresponding, apparently, to the spines or tubercles of the other valve.

Length, 0.52 inch; breadth about 0.57.

I am by no means clearly satisfied that this little shell is specifically identical with *P. subaculeatus* of Murchison, the specimens in the collection being few, and not in a very satisfactory condition for comparison. I do not think, however, that it can be distinguished from specimens that have been referred by high authorities in the Old World to *P. subaculeatus.* It nevertheless seems also to be closely allied to New York Hamilton group specimens that have been figured under other names.

Locality and position.—West side of Buell Valley, latitude 39° 30′ north, longitude 115° 36′ west.

Genus SPIRIFER, Sowerby.

SPIRIFER UTAHENSIS, Meek.

Plate 1, fig. 4, *a*, *b*, *c*.

Spirifera Norwoodi, Meek (July, 1860), Proceed. Acad. Nat. Sci. Philad., XII, 308 (not Hall, 1856).
Spirifera Utahensis, Meek (November 20, 1860), last page of extra copies of the above paper.

Shell rather small, trigonoid-semicircular, wider than long, with greatest breadth on or near the hinge-line. Ventral valve very convex at the umbo, sloping abruptly to the front and sides; beak elevated, rather pointed, and more or less arched over the area, sometimes a little twisted to one side; mesial sinus rather shallow, rounded, and extending to the point of the beak, from which it widens and deepens very gradually to the front; area triangular, but wider than high, rather distinctly arched; foramen very narrow, and apparently entirely open. Dorsal valve convex, but much more depressed than the other; mesial fold obscure in the umbonal region, slightly elevated, and rounded at the front. Surface of each valve ornamented by about forty small depressed radiating costæ, some six or seven of which occupy the mesial sinus of the ventral valve, and seven or eight the fold of the dorsal valve.

Length, 0.52 inch; breadth (along hinge-line), about 0.60 inch; convexity, 0.42 inch.

The costæ are all simple, unless a few of them bifurcate in the mesial sinus or on the fold. They generally converge to the beaks, though a portion of those near the lateral extremities seem to run out on the hinge before reaching the beaks. None of the specimens are in a condition to have preserved finer surface-markings, if there were any.

This shell is of the same type as several species found in rocks of the age of the New York Hamilton group in that and some of the Western States, but seems to be distinct from them all.

Locality and position.—Same as last.

SPIRIFER ENGELMANNI, Meek.

Plate 1, fig. 1, *a*, *b*, *c*.

Spirifera Engelmanni (July, 1860), Proceed. Acad. Nat. Sci. Philad., XII, 308.

Shell rather small, semicircular, about twice as wide as long; hinge equaling the greatest breadth, angular at the extremities. Dorsal valve depressed convex; mesial fold rather narrow, but slightly elevated, flattened along the middle, and apparently without plications. Ventral valve very convex in the umbonal region, sloping abruptly to the sides and front; beak pointed, more or less arched; area high, triangular, the hinge side being longer than the lateral slopes, which are usually somewhat angular, generally rather strongly arcuate, or inclined a little backward over the hinge; foramen very narrow, apparently open to the point of the beak; mesial sinus narrow, shallow, extending to the beak, flattened in the middle, and without plications. Surface ornamented by from seven to nine depressed, rounded, simple plications on each side of the fold and sinus.

Length of hinge, about 0.66 inch; diameter from hinge to front, 0.39 inch; height of area, 0.26 inch.

It is probable the surface was also marked with very fine striæ, and possibly granules, as is not uncommon in this section of the genus, but the specimens are not sufficiently well preserved to have retained such delicate ornaments, if they existed.

This species is quite similar in size and form to the last, but may be readily distinguished by its much larger and less numerous plications, none of which are defined on the mesial fold, or in the sinus, as in that species. As near as can be determined from a description without figures or measurements, it seems to be also related to *S. fornacula* of Hall, from the Hamilton group in Illinois (Report Regents University of New York, 1857, p. 115), but has not more than half as many plications.

Named in honor of Mr. Henry Engelmann, Geologist of Captain Simpson's exploring party.

Locality and position.—Devonian of Neil's Valley, latitude 39° 32′, longitude 115° 36′.

SPIRIFER STRIGOSUS, Meek.

Plate 1, fig. 5, *a*, *b*, *c*, *d*.

Spirifera macra, Meek (July, 1860), Proceed. Acad. Nat. Sci. Phila., 309 (not Hall, 1856).
Spirifer strigosus, Meek (1860), last page of extra copies of the above-cited paper.

Shell rather under medium size, subtrigonal, or subsemicircular, considerably wider than long; hinge-line equaling the greatest width, and terminating in rather salient angles. Dorsal valve convex in the middle, compressed toward the lateral extremities; mesial fold narrow, prominent, and angular, especially near the front. Ventral valve more convex than the other, sloping somewhat abruptly from the umbo to the sides and front; mesial sinus narrow, rather deep, with sloping sides continued to the beak, which is pointed and incurved; area of moderate breadth, with well-defined sloping lateral margins, apparently not continued quite to the extremities of the hinge, arched and inclined back over the cardinal margin; foramen triangular, higher than wide. Surface of each valve ornamented by about eighteen to twenty-four moderately distinct more or less bifurcating plications, about six or seven of which usually occupy the mesial fold, and five or six the mesial sinus.

Length of hinge, about 1.19 inches; diameter from hinge to front, 0.63 inch; height of area, 0.16 inch.

The central plication of the ventral valve usually extends along the middle of the sinus nearly or quite to the beak; while the two or three rather smaller ones in the sinus on each side, in most cases, coalesce with those forming the margin of the sinus before reaching the beak. Along the middle of the rather sharp fold of the dorsal valve there is a groove, usually a little larger than those between the other plications, and corresponding to the central plication of the opposite valve. A few of the plications on each side near the mesial sinus and fold sometimes bifurcate once, but the others seem to be all simple. The specimens are not well enough preserved to have retained fine surface-markings, if there were any.

This shell is quite unlike all of the other forms from this region, and I know of no very closely allied species from other localities.

Locality and position.—Same as last.

Genus ATRYPA, Dalman.

ATRYPA RETICULARIS (Lin.), Dalm.

Plate 1, fig. 6, *a*, *b*.

Anomia reticularis, Linnæus (1767), Syst. Nat., ed. xii, vol. 1, 1152; and Encyc. Méthod., pl. 242, fig. 4, *a*, *b*, *c*.
For the long list of subsequent synonyms, with references, &c., see Mr. Davidson's and other extended works on Palæozoic *Brachiopoda*.

Of this widely-distributed species there are quite a number of specimens in the collection from a locality near the south branch of Humboldt River. They are all rather small, and have more the aspect of Upper Silurian than Devonian varieties. As a general thing they are proportionally a little wider than usual; but they vary in this respect, and beyond a doubt belong to this well-known species.

I am not aware of this shell having been hitherto discovered at any locality within the territory of the United States, so far west by between 1,000 and 1,200 miles.

Locality and position.—Same as preceding.

ATRYPA ASPERA, Schloth.

Plate 1, fig. 2, *a*, *b*.

Terebratulites asper, Schlot. (1813), Min. Taschenb., vol. vii, pl. 1, fig. 7.
Atrypa aspera, Dalm. (1827), Vet. Acad. handl., pl. 4, fig. 3, and of many others (not J. Sowerby).
Atrypa squamosa, J. Sowerby (1840), Geol. Trans., 2d ser., vol. 5, pl. 57, fig. 1.
?Atrypa spinosa, Hall (1843), Geol. Rept. 4th District New York.

The specimens here referred to the above well-known and widely-distributed species are very small for that shell, and, being in a rather bad state of preservation, cannot be identified with positive certainty. From their general appearance and associates, however, I am led to regard them as probably a variety of that species. It should be explained here, however, that many reliable European authorities regard *A. aspera* as only a more coarsely-marked variety of the common *A. reticularis*.

Locality and position.—Same as last.

CARBONIFEROUS FOSSILS.

MOLLUSCA.

POLYZOA.

Genus ARCHIMEDIPORA, D'Orbigny.

ARCHIMEDIPORA, ——— (?)

Plate 1, fig. 11.

There are in the collection from the dark-colored limestones composing the hills west of Camp Floyd, a few fragments of one or more species of this curious group of *Polyzoa;* but as they merely consist of portions of the spiral axis, it is impossible to make out their specific characters. They are both dextral and sinistral, quite slender, and make about eight turns in the space of an inch.

No species of this genus has hitherto been found in the region of the Rocky Mountains, so far as known to the writer. Several species occur in the Lower Carboniferous series of the Western States; though I believe we have yet no well-authenticated instances of the occurrence of these forms in the Coal-Measure.

NOTE.—Up to this time (November, 1875), I have seen no other specimens of this genus from the Rocky Mountain region.

BRACHIOPODA.

Genus CHONETES, Fischer.

CHONETES VERNEUILIANA, var. UTAHENSIS.

Plate 2, fig. 2, *a*, *b*, *c*.

Chonetes Verneuiliana, Norwood and Pratten (1853), Jour. Acad. Nat. Sci. Phila., III, 1, pl. ii, fig. 6.

This little *Chonetes* is much like *C. Verneuiliana* of Norwood and Pratten; from the typical form of which, however, it differs in having a much broader and more rounded mesial sinus in the ventral valve, which sinus is also bounded by more angular and more diverging ridges than we usually see in *C. Verneuiliana.* Our Utah shell also seems to be more extended on the hinge-line, and has more sinuous lateral margins. Its striæ are exceedingly fine, closely arranged, and appear to increase both by intercalation and division. None of the specimens collected show very clearly the number of spines on the hinge-margin, though there appear to be about five on each side of the beak. No specimens of the dorsal valve were obtained. I am inclined to think it will be found specifically distinct from *C. Verneuiliana.*

Length of hinge, 0.45 inch; diameter from hinge to front, 0.22 inch; convexity of ventral valve, 0.12 inch.

Locality and position.—Near Humboldt Mountains, latitude 39° 57′, longitude 115° 10′.

Genus PRODUCTUS, Sowerby.

PRODUCTUS SEMISTRIATUS, Meek.

Plate 1, fig. 7 *a*, *b*.

P. semistriatus, Meek (July, 1860), Proceed. Acad. Nat. Sci., Philad., xii, 309.

Shell of medium size, greatest breadth on the hinge-line, which is nearly twice the length, measuring from the hinge to the anterior curve. Dorsal valve unknown. Ventral valve *very* gibbous, extremely arched, and greatly produced in front; sometimes provided with an obscure, very shallow mesial sinus, which never extends to the beak; ears triangular, strongly vaulted, extended nearly at right angles to the vertical sides of the elevated visceral arch, from which they are each separated by an oblique, undefined sulcus; beak very convex, distinctly incurved, and extended a little beyond the hinge; surface of the visceral region marked by small, obscure concentric wrinkles, which are crossed by numerous, more or less bifurcating striæ; anterior half smooth, or only marked by fine lines of growth; spines rather long, erect, and scattering.

Length of hinge, 1.19 inches; diameter from hinge to anterior curve, 0.72 inch; length from the beak to the anterior margin of the ventral valve, measuring over its curve, 2.14 inches.

The concentric wrinkles are most distinct on the lateral slopes of the visceral arch, and seem to extend upon the ears. When the radiating striæ are well defined, they form, with these wrinkles, a more or less distinct reticulate style of ornamentation, over the visceral half of the shell. The radiating striæ are generally rather obscure, and number about ten in the space of 0.30 inch.

This species belongs to the group *Semireticulati* of Koninck; its most marked peculiarities are its narrow, strongly arcuate form, produced anterior, and the entire absence of radiating striæ over the whole of the ventral valve, excepting the visceral half. These characters will serve to distinguish it from all the other forms resembling it in other respects, yet known to the writer.

Locality and position.—Timpanogos Cañon, latitude 40° 22′, longitude 111° 38′; in a dark, argillaceous rock, probably of the age of the Coal-Measures.

PRODUCTUS MULTISTRIATUS, Meek.

Plate 1, fig. 8, *a*, *b*.

Productus multistriata, Meek, (July, 1860), Proceed. Acad. Nat. Sci., Philad., xii, 309.

Shell above medium size, breadth nearly double the length, from the hinge direct to the anterior slope; hinge-line longer than the breadth of the shell in front of it; ears moderately large, triangular, distinctly vaulted, and standing nearly at right angles to the swell of the larger valve. Ventral valve extremely ventricose, strongly arched, and provided with a broad, deep mesial sinus, extending from the beak to the front; beak rather small, compressed, and projecting little beyond the hinge. Dorsal valve deeply concave, provided with three broad, obscure radiating prominences, one of which corresponds to the mesial sinus of the other valve, and the other two radiate to the lateral margins in front of the ears. Surface of both valves marked by numerous very fine, obscure, radiating striæ, and destitute of spines, excepting about three near the extremity of each ear, and a few on the anterior slope of the ventral valve.

Length of hinge, near 1.77 inches; length from hinge to anterior slope, 1 inch; greatest breadth in front of the hinge, 1.48 inches.

None of the specimens show concentric lines or wrinkles, but as they are all a little worn, there may have been very fine marks of growth. The radiating striæ are small, very regular, and number about ten to twelve in the space of 0.20 inch; they appear to increase chiefly by intercalation. The swell of the arched portion of ventral valve is very prominent, and has, in consequence of the deep mesial sinus, a more or less distinct bilobate appearance; while the lateral slopes are very abrupt, and its anterior and lateral margins considerably produced. Judging from the few remaining bases of spines on the ventral valve, they seem to have been strong and erect.

Locality and position.—Yellowish limestone series, east side of Long Valley, latitude 39° 57′ north, longitude 115° 10′ west, where it is quite common; probably Upper Carboniferous.

Genus ATHYRIS, McCoy.

ATHYRIS SUBTILITA, Hall (sp.).

Plate 2, fig. 4, *a*, *b*.

Terebratula subtilita, Hall (1852), Stansbury's Rept. Expl. Great Salt Lake, 4, pl. 1, *a*, *b*, and 2, *a*, *b*.

Terebratula? subtilita, Davidson (1857), Monogr. Brit. Carb. Brach., 18, pl. ii, figs. 21 and 22.—Marcou (1858), Geol. N Am., 52, pl. vi.

Spirigera subtilita, Meek and Hayden (1859), Proceed. Acad. Nat. Sci. Philad., IX, 20.

Athyris subtilita, Newberry (1861), Ives's Colorado Report, 126.—Davidson (1863), Brach. of S. India, pl. ix, fig. 7.—Salter, (1861), Quart. Jour. Geol. Soc. Lond., XVII, pl. iv, fig. 4, *a*, *b*.—Meek (1872), Paleont. E. Nebraska 180, pl. i, fig. 12; pl. v, fig. 8; and pl. viii, fig. 4.

There are several characteristic specimens of this well-known shell in the collections from the Coal-Measures of Eastern Kansas, and quite a number of apparently the same species from the Yellow Limestone series so extensively developed in the central region of the Great Salt Lake Basin, near Humboldt Mountains. The specimen figured, which is rather smaller than the average size of its associates, is from the latter locality. Some of the larger specimens are more compressed, and have a more distinct mesial sinus than the one figured. None of those from this distant western locality are in a condition to show the interior; but, so far as can be determined, they present no external differences from Professor Hall's species.

This seems to be one of the most widely distributed species of all those known in the Carboniferous rocks. It ranges from Eastern Ohio, through Indiana, Illinois, Missouri, and Kansas, westward to the middle of the Great Salt Lake Basin, and from Nebraska far into New Mexico. Mr. Marcou also says he has received it from Vancouver's Island;* and Mr. Davidson identifies it from the Carboniferous rocks of England, as well as from India, and it also occurs in South America.

It is a little remarkable that in this country *Athyris subtilita* is, so far as known, peculiarly characteristic of the Coal-Measures, while in England it appears to occur only in the Lower Carboniferous rocks. Mr. Davidson once referred it to the genus *Terebratula*, with a query, not having seen the interior. Several of the specimens, however, found by Dr. Hayden and the writer in Eastern Kansas, in the same beds from which those first described by Professor Hall were obtained, show the internal spiral appendages and other characters of the genus *Athyris*, or *Spirigera*, as it may have to be called.

Genus SPIRIFER, Sowerby.

SPIRIFER (SPIRIFERINA?) SCOBINA, Meek.

Plate 2, fig. 5, *a*, *b*, *c*,

Spirifera scobina, Meek (July, 1860), Proceed. Acad. Nat. Sci., Philad., XII, 310.

Shell rather large, truncato-subcircular, approaching subpentagonal, moderately gibbous, length and breadth nearly equal, hinge-line scarcely equaling the greatest breadth; lateral margins rounding anteriorly and intersecting the hinge almost at right angles; valves nearly equally convex, each provided with from about seventeen to twenty-two rather broad, depressed, occasionally bifurcating, plications. Ventral valve a little more gibbous than the other, and having a shallow mesial sinus, which is very small near the beak, but widens gradually toward the front; beak moderately prominent, incurved; area of medium breadth, with nearly parallel margins, extending to the lateral extremities of the hinge, distinctly arched near the beak; foramen having nearly the form of an equilateral triangle. Dorsal valve moderately convex in the umbonal region; beak rather prominent and incurved; mesial fold depressed, not distinctly defined excepting at the front, where it is generally flattened. Surface of both valves apparently without striæ, but beautifully ornamented by numerous minute regularly disposed granules.

Breadth, 2 inches; length, 1.88 inches; convexity, 1.34 inches.

From about three to five of the plications usually occupy the mesial sinus, and near the same number the mesial fold, in the former of which they are generally a little smaller than on each side. On some specimens most of the plications are simple, while in other instances a portion of them bifurcate, though rarely more than once. The plications are usually about twice as broad as the grooves between. The mesial sinus is never very strongly defined, and sometimes becomes almost obsolete near the beak. Where the surface has been a little worn, the fine granules are entirely obliterated, but on well-preserved specimens they present a very beautiful appearance under a lens. Scarcely any marks of growth are visible in most cases.

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* I think this an error, however, as I have never heard of any other evidence of Carboniferous rocks there.

From its regularly granulated surface, and some appearance of punctures seen on exfoliated surfaces, I am led to suspect that this shell may be a *Spiriferina*, but I am not sure that it possesses the internal lamina of that type.

This is a well-marked species, very distinct from all the forms I have seen in any of the Carboniferous rocks of the Western States, and seems not very nearly related to any known foreign species.

Locality and position.—Divide between Long and Ruby Valleys. Latitude 40° north, longitude 115° 20′ west. From the yellowish limestone series, probably Upper Carboniferous.

SPIRIFER (SPIRIFERINA) PULCHER, Meek.

Plate 2, fig. 1, *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*.

Spirifera pulchra, Meek (July, 1860), Proceed. Acad. Nat. Sci. Philad., XII, 310.

Shell of medium size, more or less compressed, length from one-half to one-third the breadth; hinge-line equaling the greatest width; lateral extremities often much extended, compressed, and acutely pointed. Ventral valve more convex than the other in the umbonal region; beak rather small, and not very strongly incurved; area somewhat narrow, very slightly arched, or inclined back over the hinge, its margins being subparallel; foramen triangular, a little higher than wide; mesial sinus narrow, well defined, rather deep, and smoothly rounded within, extending to the point of the beak, from which it widens very gradually toward the front; lateral slopes on each side of the mesial sinus of the ventral valve, and its corresponding elevation on the dorsal valve, bearing from seven to nine simple, elevated, rather narrowly-rounded plications. Entire surface ornamented by fine, regularly disposed granules, which, on worn or exfoliated specimens, are seen to be connected with punctures; marks of growth moderately distinct, and more or less arched in crossing the plications and mesial fold.

Length of largest specimen, 1.13 inches; breadth, 3.10 inches; convexity, 0.76 inch.

This is quite easily distinguished from any of its associates, and not very nearly related to any Carboniferous species I have yet seen from other localities. The delicate granulations seen on its surface are also well marked on the surfaces of the exfoliated lamina, and are likewise represented by the usual corresponding punctures on the interior. It varies much in the comparative length of the hinge, though the breadth of the shell is in all cases considerably greater than its length. The individuals having the shortest hinge are also usually more gibbous than the others.

Internal casts of this shell show that it has the mesial septum of its ventral valve well developed, which, with its distinctly punctate structure, requires its removal to *Spiriferina*, whether we view that group as a genus or a subgenus.

Locality and position.—East and west side of Long Valley, and pass east of Ruby Valley. Latitude 40° north, longitude 115° 20′ west. Geological position same as last.

SPIRIFER CAMERATUS, Morton.

Plate 2, fig. 3, *a*, *b*.

Spirifer cameratus, Morton (1836), Am. Jour. Sci. and Arts, XXIX, 150, pl. 2, fig. 3.—Hall (1858), Report Geol. Survey of Iowa, 709, pl. xxviii, fig. 2.—Meek (1872), Palæont. E. Nebraska, 183, pl. vi, fig. 12; and pl. viii, fig. 15.

Spirifer Meusebachanus, Roemer (1852), Kreid. von Texas, 88, pl. xi, fig. 7.

Spirifer triplicatus, Hall (1852), Stansbury's Report Great Salt Lake Exp., 410, pl. ii, fig. 5, (by error pl. 4.)

Compare *Spirifer fasciger*, Von Keyserling (1847), Petsch., 231, pl. 5, fig. 3.

After a very careful comparison of our specimens of this shell with a good series of Morton's species cited above, from the Coal-Measures of Kansas and other western localities, I am left in some doubt in regard to their identity. It is true *S. cameratus* is a variable form, but all the specimens of it I have yet seen are less robust, more finely plicated, and usually have a narrower area. The plications of the Utah specimens are also generally less distinctly fasciculate, though they vary in this respect somewhat.

In some respects our shell resembles a form figured by Prof. Marcou in his work on the Geology of North America, under the name of *Spirifer striatus* var. *triplicatus*, but its plications are coarser and more irregular in their mode of branching, while its mesial elevation is much less prominent and not near so angular.

So far as yet known *Spirifera cameratus* of Morton, is, in this country, peculiarly characteristic of the Coal-Measures, and can always be distinguished at a glance from any of the forms occurring in our Lower Carboniferous rocks. It is an interesting fact, however, that they find in the Lower Carboniferous series of the Old World, forms regarded by the most trustworthy authorities as varieties of *Spirifer striatus*, Martin, which are apparently undistinguishable from Morton's *S. cameratus*. One of Mr. Davidson's figures of *S. striatus* var. *attenuatus* (fig. 13, pl. II), given in his admirable Monograph of the British Carboniferous Brachiopoda, published by the Palæontographical Society, is almost as good a representation of some specimens of Morton's *S. cameratus* as could be drawn; while Mr. Davidson, whose opinion is worthy of the fullest confidence, says he finds so many gradations between this form and the large varieties of *S. striatus*, with coarser, uniform plications, that they cannot be considered distinct species. Yet it is very remarkable that we should have in the Lower Carboniferous rocks of this country very closely allied representatives of the large varieties of *S. striatus* (if not indeed that species itself*), and in the Coal-Measures others scarcely if at all distinguishable from *S. striatus* var. *attenuatus*, while we find no connecting links between these forms at either of these horizons, nor in any of the beds of passage between them.

Locality and position.—Summit Spring Pass, east of Long Valley, and between Long and Ruby Valleys; latitude, 39° 33′ to 40° north, longitude, 115° 12′ to 20′ west. Position, same as last.

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* See *Sp. Logani*, Hall, Iowa Report, vol. 1, part 2, pl. 21, fig. 1, 2, 3.

LAMELLIBRANCHIATA.

Genus AVICULOPECTEN, McCoy.

AVICULOPECTEN UTAHENSIS, Meek.

Plate 1, fig. 9, *a*, *b*, *c*.

Pecten Utahensis, Meek (July, 1860), Proceed. Acad. Nat. Sci., Philad., XII, 310.

Shell of medium size, thin, subcircular, much compressed, apparently nearly equivalve, the left valve being slightly more convex than the other; ears small, subequal, triangular, and distinctly flattened; posterior ear truncated nearly at right angles to the hinge, sometimes a little rounded on the truncated edge; anterior ear separated from the margin by a very shallow sinus; surface of the left valve ornamented by rather obscure, unequal, depressed, radiating costæ, and numerous extremely fine, equidistant, thread-like, concentric lines, scarcely visible without the aid of a lens; right valve smooth, or only marked by fine concentric striæ.

Length, about 1.10 inches; breadth, 1.20 inches; length of hinge, 0.57 inch.

Sometimes the radiating costæ are nearly equal, but usually there are two, three, four or more smaller ones between each two of the larger. The smaller costæ generally die out or coalesce with each other or the larger ones before reaching the beak. They are all usually obsolete on the lateral margins, and always wanting on the ears, which are only marked by fine, closely-arranged, concentric striæ.

Locality and position.—Summit Spring Pass, divide between Long and Ruby Valleys; latitude, 39° 33′, longitude, 115° 12′ west. Probably Upper Carboniferous.

CEPHALAPODA.

Genus ORTHOCERAS, Auct.

ORTHOCERAS BACULUM, Meek.

Plate 1, fig. 10, *a*. *b*.

Orthoceras baculum, Meek (July, 1860), Proceed. Acad. Nat. Sci. Philad., XII, 310.

Shell rather small, elongate-conical; section very nearly circular near the smaller end, and slightly oval toward the aperture; sides diverging from the apex at an angle of 8°; septa not oblique, distinctly concave on the anterior side, separated by spaces equal to one-fifth their own greater transverse diameter; siphuncle rounded, nearly but not quite central, a little less than one-sixth the diameter of the shell; surface apparently smooth.

The only specimen of this species in the collection is a fragment, imperfect at both extremities, and about two inches in length, with a diameter at the smaller end of 0.47 inch. Although it retains no surface-markings, there may be fine lines of growth on well-preserved specimens.

In form and proportions this shell is quite similar to two or three species described by de Koninck from the Carboniferous rocks of Belgium. It differs, however, from his *O. Goldfussianum* (pl. xliii, figs. 3 and 4, Animaux fossiles), which it seems to resemble more than any species known to me, in having its siphuncle slightly excentric, though not so much so as in his *O. laterale*, and in having its septa arranged so as to be separated by spaces equaling about one-fifth instead of only one-eighth the diameter of the shell.

Locality and position.—East side Ruby Valley; latitude, 40° north, longitude, 115° 20′ west. Probably Lower Carboniferous.

JURASSIC SPECIES.

RADIATA.

ECHINODERMATA.

Genus PENTACRINITES, Miller.

PENTACRINITES (undt. sp.).

Plate 3, fig. 5, *a*, *b*, *c*.

Numerous fragments of the column and its appendages, of this Crinoid were found in the Jurassic beds near the Red Buttes, on the North Platte. It seems to differ from *P. asteriscus*, Meek and Hayden, characteristic specimens of which also occur at the same locality, in having a more slender and much less distinctly angular column, though it may possibly belong to the same species, the column in Crinoids being very variable in form.

MOLLUSCA.

LAMELLIBRANCHIATA.

Genus OSTREA, Linn.

OSTREA ENGELMANNI, Meek.

Plate 3, fig. 6.

Ostrea Engelmanni, Meek, (July, 1860), Proceed. Acad. Nat. Sci. Philad., XII, 311.—Meek and Hayden (1865), Palæont Upper Mo., 73, wood-cuts A and B.

The collection contains only upper valves of this species, all of which are much compressed, rather thin and subovate, or more less irregular in form. Beak distinctly truncated, and provided with a broad but short area; surface ornamented by from five to about fifteen irregular, moderately distinct, rather rounded, radiating plications, which do not usually extend upon the umbonal region, but become quite distinct at the border, which is usually thin; lines of growth regular and moderately well defined, but not imbricating. Muscular scar rather large, ovate and distinct.

Length (of the largest specimen), 3.50 inches; breadth, 3.0 inches.

This oyster bears some resemblance to *O. Marshii* of Sowerby, but appears to be a much thinner shell, and differs remarkably in the length of the area of the upper value, which is, in none of the specimens brought in, more than one-third as long as in individuals of *O. Marshii* of the same size, nor is it so concave in the middle as in that species; while its plications are not so prominent or angular.

It is also somewhat similar to a form referred by Prof. Jules Marcou in his Geology of North America, pl. iv, fig. 4, to *O. Marshii.* The shell now under consideration, however, is thinner, and differs in being without imbricating marks of growth, while its plications are smaller. In addition to this, the shell figured by Mr. Marcou is now known to be a Cretaceous species, that holds a position far above the horizon from which *O. Engelmanni* was obtained.

This species is named in honor of Mr. Henry Engelmann, of Saint Louis, Geologist of Captain Simpson's expedition.

Locality and position.—Jurassic beds at Red Buttes, on the North Platte, latitude 42° 50′, longitude 106° 40′ west.

GRYPHÆA CALCEOLA, Quenstedt ?.

Plate 3, fig. 2.

Ostrea calceola Roemer (?), Oölite, Geb. tab. 18, fig. 19.
Gryphœa calceola, Quenstedt ? (1856), Der Jura, I, 353, pl. 48, fig. 1–3.

Several specimens undistinguishable from the species cited above were obtained from the Jurassic beds near the Red Buttes, on the North Platte. The specimen figured has the form and other characters of a true *Gryphœa;* but some of the others have the whole beak truncated, and present more the appearance of *Oystrea;* though there seem to be intermediate gradations between these forms. They show clearly the radiating striæ seen on the under valve of *G. calceola*, as known in Europe.

Genus CAMPTONECTES, Agassiz.

CAMPTONECTES BELLISTRIATA, Meek.

Plate 3, fig. 3, *a*, *b*, *c*, *d*.

Pecten bellistriata, Meek (July, 1860), Proceed. Acad. Nat. Sci. Philad., XII, 311.
Camptonectes bellistriata, Meek (1864), Smithsonian Check-List N. Am., Juras. Fossils, 28; and (1865) Palæont. Upper Mo., 77, wood-cuts A, B, C.

Shell of medium size, subcircular, sometimes wider than long, thin, compressed, nearly or quite equivalve; hinge straight and very short; posterior wing small or nearly obsolete, obliquely truncated; anterior wing small, vertically truncated at the extremity, and in the right valve separated from the margin below by a distinct more or less angular sinus, from which a shallow flat groove extends obliquely to the beak; beaks of both valves small, and rather compressed; surface ornamented by numerous fine, arched, bifurcating strae, crossed by extremely small, closely arranged concentric lines, which are often nearly obsolete on the radiating striae over the more convex portions of the valves, but quite distinct in the slender depressions between, to which they impart a punctate appearance.

Length (broad variety), 2.26 inches; breadth, 2.65 inches; convexity, 0.64 inch.

The radiating striæ, of which about six to seven may be counted in the space of one-tenth of an inch near the border on the middle of the valves, are more crowded on the lateral margins, where they curve strongly outward. They are separated by exceedingly delicate impressed lines, and on some parts of the shell occasionally present the peculiarity of bifurcating, and again coalescing at intervals. On the lateral margins the concentric striæ are usually well defined and very regular, so as to form with the radiating striæ a fine cancellated style of ornamentation. Only concentric markings appear to be well defined on the anterior wing of the right valve.

This shell is very closely related to the Jurassic species *C. lens* (= *Pecten lens* of Sowerby), having much the same form, and almost exactly the same style of ornamentation. It differs, however, from all the figures I have seen of *P. lens*, in being usually broader in proportion to its length, and its hinge is also proportionally much shorter, being generally less than one-third the greatest breadth of the shell, while that of Sowerby's species is represented from one-half to three-fourths as long as the breadth of the widest part of the valves below. The posterior wing of our species is also much smaller and obliquely truncated so as to form a much more obtuse angle with the hinge-line.

Professor Agassiz, the founder of the genus *Camptonectes*, informed me that on making careful comparisons of European specimens, he was satisfied that some three or four distinct species have long been confounded under Sowerby's name *Pecten lens.*

Locality and position.—Same as last.

GASTEROPODA.

Genus DENTALIUM, Linn.

DENTALIUM ? SUBQUADRATUM, Meek.

Plate 3, fig. 1, *a, b, c.*

Dentalium ? subquadratum, Meek (July, 1860), Proceed. Acad. Nat. Sci. Philad., XII, 311.

Shell small, slender, regularly and slightly arcuate, very gradually tapering, flattened or a little concave on four sides so as to present a subquadrangular section, the angles being a little rounded; section of internal cavity circular; surface apparently without longitudinal striæ or marks of growth.

Length, about 1 inch; diameter at larger end, 0.05 inch; diameter at the smaller extremity, 0.02.

This fossil is found in great numbers, associated with fragments of *Belemnites* and *Pentacrinites*, in thin pieces of gray, sandy, calcareous rock. It has the usual proportions and curve of *Dentaliumi;* but the texture, quadrangular form, and surface characters of the shell give it considerably the appearance of *Serpula* and some allied genera. I was at first inclined to suppose it might be an appendage of a *Pentacrinites*, but as it presents no traces of a jointed structure, and has a large internal cavity, this cannot be the case.

Whatever may be the true relations of these bodies, they will probably be of use in the identification of the formation in which they occur, and should not be overlooked by the Paleontologist, in consequence of their doubtful zoölogical relations. I suspect that it will form the type of a distinct genus.

Locality and position.—Jurassic beds on the North Platte, at Red Buttes, latitude, 42° 50′ north, longitude, 106° 40′ west.

CEPHALOPODA.

Genus BELEMNITES, Lamarck.

BELEMNITES DENSUS, Meek and Hayden.

Plate 3, fig. 4, *a. b.*

Belemnites densus, Meek and Hayden (March, 1858), Proceed. Acad. Nat. Sci. Philad., X, 58; also (1865), Palæont. Upper Missouri, 126, pl. iv, fig. 10, *a*, *b*, *c*, and pl. v. *a–h*.

Many imperfect specimens of this species were collected from the Jurassic rocks on the North Platte, near the Red Buttes. They agree exactly in all respects with those brought by Lieutenant Warren's expedition from the Jurassic beds at the southwest base of the Black Hills. This species is very closely allied to forms found in the Jurassic deposits of France and Russia; and may, on comparison, prove identical with some one of these foreign species. I have never yet seen an entire specimen of it, though it is quite abundant, and all parts of it can be seen in detached fragments. It probably attained a length of about 4.50 to 5 inches.

CRETACEOUS FOSSILS.

LAMELLIBRANCHIATA.

Genus INOCERAMUS, Sowerby.

INOCERAMUS PROBLEMATICUS, Schloth.

Plate 4, fig. 1, *a* (and 1 *b*, *c*?).

Mytilites problematicus, Schlotheim (1820), Petrefact., 312.
Mytiloides lobatus, Brong. (1822), Geol. des Envir. de Paris, 215, pl. 3, fig. 4.
Inoceramus mytiloides, Mantel (1822), Geol. Sussex, tab. xxvii, fig. 3; and tab. xxviii, fig. 2.—Sowerby (1823), Min. Conch., v, 61, 442.—Goldf. (1836), Petref. Germ., II, 118, pl. cxiii, fig. 4.—? Roemer (1842), Kreid. von Texas, 60, tab. vii, fig. 5.
Catillus Schlotheimii, Neilson (1827), Petref. Suecana, 19.
Catillus mytiloides, Deshayes (1830), Encycl. Méth., II, 211.
Inoceramus problematicus, d'Orbigny (1843), Paléont., Fr., III, Terr. Crét., 510, 406.—Meek and Hayden (1857), Proceed. Acad. Nat. Sci. Philad., IX, 119.—Meek (1864), Smithsonian Check-List N. Am. Cret. Fossils.—Meek, Palæont. Upper Missouri Basin and contiguous country, 62, pl. 9, fig. 3 *a b*.
Inoceramus pseudo-mytiloides, Schiel (1855), Report Pacific Railroad, II, 108, pl. 3, fig. 8.
? *Inoceramus mytilopsis*, Conrad (1858), U. S. Mexican Bound. Report, I, 152, pl. 5, fig. 6.

Shell rhomboid-ovate, oblique, moderately convex; anterior margin truncated above, from the beaks at first obliquely backward and downward, thence passing by a gentle oblique curve into the base; posterior margin descending obliquely backward, with a slightly convex outline; postero-basal extremity rather narrowly rounded; hinge comparatively short, and standing at an angle of about 60° to 90° from the slope of the anterior margin; beaks oblique, rather convex, but narrow, pointed, nearly or quite terminal, rising little above the hinge. Surface ornamented by distinct concentric undulations, which are subangular, nearly simple, and quite regular on some specimens, but more rounded and irregular on others. Between these undulations traces of finer marks of growth are also sometimes seen.

Length of largest specimen about 3 inches; breadth of same near 1.50 inches.

This is one of the forms that have been very generally referred to *I. problematicus* from western localities, though it may possibly be distinct from that species. The specimens brought in by Captain Simpson's survey are not in a very satisfactory condition, as may be seen by the figure. Since that time I have visited the locality, and collected many others. They show it to vary considerably in form, some having the hinge-line ranging much less obliquely to the axis of the umbones than others. These latter show a slight tendency to have the posterior dorsal margins compressed and subalate, and appear nearly equivalve, while there seem to be various gradations of form between these extremes. The specimen represented by our figure 1 *a*, of plate IV, has the beak and dorsal margin broken away, so that the restoration in dim shade in the figure may not represent exactly the direction of the hinge-line with relation to the umbonal axis. There are also among the specimens that I have seen since first writing this report, considerable variations in the ornamentation, some having very regular, and others irregular undulations. Some, however, such as that represented by our figures 1 *b*, *c*, I think most probably belong to a distinct species from the majority of the others, and seem to be generally smaller and much more regularly undulated. Some of these closely resemble a form that Dr. White has named *I. dimidius*, in Lieutenant Wheeler's report (not yet published at the time of the revision of this report, November, 1875).

If the forms like our figure 1 *a*, Pl. IV, are distinct from *I. problematicus*, I think Dr. Schiel's name, *I. pseudo-mytiloides*, will have to be retained for the species. These shells generally have the beak more pointed and curved downward than in European specimens of *I. problematicus*, and sometimes have the hinge-line ranging at a greater angle with the umbonal axis than in any figures of European specimens of that species that I have yet seen.

The figures 2 *a*, *b*, of Plate IV, represent smaller specimens, with much less oblique beaks and a general outline more rounded. They are probably only the umbonal positions of larger specimens, the specific relations of which remain doubtful.

Locality and position.—Bear River, near the mouth of Sulphur Creek, Wyoming. Cretaceous.

Genus ANOMIA, Linn.

ANOMIA CONCENTRICA, Meek.

Plate 4, fig. 3.

Anomia concentrica, Meek (July, 1860), Proceed. Acad. Nat. Sci., Philad., XII, 311.

Shell small, thin, subcircular or transversely a little oval; lateral extremities nearly equally rounded; cardinal margin rather straight, or but slightly arched; beak very small, marginal, compressed, not projecting beyond the cardinal border; surface of upper valve ornamented by moderately distinct, regular, concentric undulations, and much smaller obscure lines of growth.

Transverse diameter 0.64 inch; length from hinge to the opposite margin, 0.50 inch.

Locality and position.—Same as last.

INOCERAMUS SIMPSONI, Meek.

Plate 4, fig. 4.

Inoceramus Simpsoni, Meek (July, 1860), Proceed. Acad. Nat. Sci., Philad., XII, 312.

Shell attaining a large size, transversely elongated or narrow, oval, gibbous in the umbonal and anterior regions, cuneate posteriorly; anterior side rounded; anal side very long, usually broader than the other, and subtruncate at the extremity; base in young shells semiovate, being more convex behind than in front, in large specimens rounding up very gradually toward the front, and apparently a little contracted or slightly sinuous behind; hinge straight, long, and ranging nearly parallel to the longer axis of the valves; beaks rising little above the cardinal border, rather convex, located very near the anterior extremity; surface ornamented by moderately distinct, rather regular concentric undulations, which sometimes bifurcate on the flanks; lines of growth small, regular, and equidistant.

Length, 8.10 inches; height, 4.35 inches; convexity, about 3.72 inches.

The remarkably elongated transverse form of this shell will serve to distinguish it from any other species yet known in our rocks, resembling it in other respects. Goldfuss figures a somewhat similar form (Taf. cxii, fig. 4 *d*, Petrefact. Germ.) under the name of *I. Cripsii*, Sowerby; though the identity of the specimen from which his figure was drawn with Sowerby's species seems to be doubtful. At any rate, it differs from that now under consideration, in having more pointed beaks, which are much more remote from the anterior end of the shell; it is likewise broader posteriorly than our species, which is much larger and more robust.

In the position and obliquity of its beaks, as well as in some other respects, *I. Simpsoni* resembles a form I have elsewhere referred to *I. Barabini* as a variety *cuneatus;* but it is a much larger shell, proportionally more elongated, and narrower posteriorly, while it comes from a geological horizon far below the known range of any shells yet found associated with *I. Barabini*, *var. cuneatus.*

The specific name of this fine *Inoceramus* was given in honor of Capt. J. H. Simpson, commander of the explorations across the Great Basin of Utah.

Locality and position.—North Platte, above the bridge; from about the horizon of No. 3 of the Upper Missouri Cretaceous series.

BEAR RIVER FRESH-WATER OR ESTUARY BEDS.

In first preparing this report (in 1860), I referred the fossils from the above-mentioned beds to the Tertiary, believing them to be Lower Eocene. After visiting the locality, however, as elsewhere stated, I was led to believe them much more probably upper beds of the Cretaceous; and now, in revising this report (in 1875), place them together here in a separate division.

MOLLUSCA.

LAMELLIBRANCHIATA.

Genus UNIO, Retzius.

UNIO VETUSTUS, Meek.

Plate 5, fig. 12, *a*, *b*.

Unio vetustus, Meek (July, 1860), Proceed. Acad. Nat. Sci., Philad., XII, 312.

Shell rather thin in young, but becoming proportionally thicker with age, attaining a medium size, transversely-ovate, moderately convex; anterior side rounded; basal and dorsal margins nearly straight and parallel in the young, but the former more convex in the adult; posterior side very long, more compressed, and rather narrower than the other, obliquely truncated above and angular below in young shells, but becoming more rounded with age; beaks small, much depressed, located near the anterior end; surface of young specimens ornamented by fine, regular, concentric wrinkles, crossed on the posterior umbonal slopes of each valve by two sharply-defined linear ridges, which radiate from the beaks nearly or quite to the posterior extremity. On old and medium-sized specimens, these markings become nearly or quite obsolete, excepting near the beaks.

Length of a large specimen, 3.22 inches; height, 1.30 inches; convexity, about 0.60 inch.

The nature of the matrix in which these specimens are imbedded, is such that it was found impossible to remove it from the hinge and interior, so as to see all the details of the teeth and muscular impressions; but by working it away with care from the hinge, I was enabled to determine beyond doubt that it is a *Unio.*

In surface-markings, young individuals of this species bear considerable resemblance to young specimens of *U. priscus*, Meek and Hayden, from the Tertiary deposits of the Upper Missouri, with which I have sometimes thought them identical. Until we can have better specimens, however, of the Upper Missouri shell for comparison, it will be better to keep them separate, especially as the relative geological positions of the beds in which the two forms occur still remain doubtful, while the Bear River beds seem to be very local in Wyoming.

Locality and position.—Brackish- or fresh-water beds on Bear River near the mouth of Sulphur Creek; latitude, 41° 12′ north, longitude, 110° 52′ west: probably belonging to the latest division of the Cretaceous.

Genus CORBULA, Bruguière.

CORBULA (ANISORHYNCHUS) PYRIFORMIS, Meek.

Plate 5, figs. 9 and 10.

Corbula (*Potamomya*) *pyriformis*, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 312.
Corbula (*Potamomya*) *concentrica*, Meek, ib., 312.
Corbula (*Anisorhynchus*) *pyriformis*, Meek (1872), Hayden's 2d Ann. Report U. S. Geol. Survey of the Territories, 298.

Shell transversely-pyriform, nearly or quite equivalve, moderately thick, very gibbous in the anterior and umbonal regions, more compressed and subrostrate behind;

buccal side truncated above from the beaks obliquely forward, rounding rather abruptly into the base below; posterior side much narrower and longer than the other, and very sharply rounded or slightly truncated at the extremity; base semiovate, being much more prominent in the central and anterior regions than behind; dorsal outline declining from the beaks at an angle of about 100°, the posterior slope being distinctly concave. Beaks prominent, equal, incurved, and located half-way between the middle and the anterior end; lunule deeply excavated, but not defined by a distinct marginal angle; escutcheon lanceolate, rather deep, and circumscribed by a marginal ridge; surface marked by fine lines of growth, with usually more or less distinct concentric ridges and furrows.

Length, 1.30 inches; height, 0.85 inch; convexity (of a right valve), 0.39 inch.

This species is quite abundant, but, in all the specimens obtained, the hard calcareous matrix adheres so firmly about the hinge that it is impossible to clear it away so as to see the teeth. Judging from the form of the shell, however, and the fact that it is associated with fresh-water and estuary species, there is little room for doubt in regard to its generic relations.* Most of the specimens are right valves; a few left valves, however, were obtained, which indicate that the species is only slightly inequivalve.

This shell varies much in its surface-markings; some specimens showing only concentric striæ, and others concentric furrows and ridges. At first I thought there might be two distinct species, separable on this character; but, after seeing large collections, I found all intermediate gradations between these extremes, and united the two under the first name.

Locality and position, same as last.

CORBULA ENGELMANNI, Meek.

Plate 5, fig. 13, *a*, *b*.

Corbula (*Potamomya*) *Engelmanni*, Meek, (July, 1860), Proceed. Acad. Nat. Sci. Philad., XII, 313.

Shell rather small, transversely subovate, gibbous in the umbonal region; anterior side narrowly rounded; base semiovate, being more prominent toward the front than behind; posterior side narrow, and truncated at the immediate extremity, having a moderately distinct angle extending from the back part of the beaks obliquely backward to the lower part of the slightly truncated posterior end; beaks depressed, located in advance of the middle; surface ornamented by small, very regular, concentric wrinkles; hinge and interior unknown.

Length (of a right valve), 0.39 inch; height, 0.21 inch; convexity, 0.11 inch.

This little shell seems to differ materially in form from the last; but owing to its small size, and the fact that specimens certainly belonging to that species vary in form, I am not quite sure that it may not be a young example of the same. Until specimens showing the intermediate connecting links can be found, however, I prefer to keep them separate.

Locality and position.—Same as last.

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*Long after writing the above, I succeeded in working out the hinge, and found it to agree well with that of *Corbula*, and not with *Potamomya*. Mr. Conrad wrote me that he had proposed to found a genus *Anisorhynchus* for its reception, mainly on its apparent fresh-water habits; but I am not satisfied that it is generically distinct from *Corbula*.

GASTEROPODA.

Genus PYRGULIFERA, Meek.

PYRGULIFERA HUMEROSA, Meek.

Plate 5, fig. 6, *a*, *b*, *c*.

Melania humerosa, Meek (July, 1860), Proceed. Acad. Nat. Sci. Philad., XII, 313.
Pyrgulifera humerosa, Meek (1872), in Hayden's Second Ann. Report U. S. Geol. Survey of the Territories, 299.

Shell rather thick, subovate; spire conical, moderately elevated; volutions about five and a half, distinctly shouldered, and more or less angular, last one comparatively large, rounded and contracted below; suture distinct; surface ornamented by about fourteen rather strong, regular, vertical folds or costæ to each turn; folds obsolete on the lower part of the body-whorl, but becoming more strongly defined at the shoulder, where they often terminate in very prominent nodes, so as to give the whorls a distinctly coronate character; crossing these folds or costæ, there are on each volution of the spire about four, and on the last whorl some seven or eight, regular, equidistant revolving lines, or small ridges.

The specimens of this interesting species are too imperfect to afford accurate measurements, but some of them appear to have been, when entire, about 1 inch in length, and 0.60 inch in breadth. One individual (see fig. 6 *b*, plate v), apparently of this species, shows the aperture to be narrow-oval. On this specimen, which consists of scarcely more than the body-whorl, the costæ do not terminate above in as prominent nodes as in others, but merely form small tubercles at the shoulder, which is more sloping than in most of the other specimens.

This species bears considerable resemblance to *Melanopsis armata* of Matheron (which seems to be a *Melania* or *Tiara*), from the Tertiary Lignite formations at the mouth of the Rhone (see Cat. Méthod. Corps Org. Foss. Départ. des Bouches-du-Rhône, plate 37, fig. 12), but differs in having the folds or costæ more distinct, and developed on the whorls of the spire as well as on the last volution. These costæ also in the species under consideration differ in terminating in rounded prominences, while upper ends of the French species seem to be flattened horizontally, and its revolving lines are much more numerous than those of our species.

Long after writing the above, I had an opportunity to examine hundreds of specimens of this shell, and in a very few examples I succeeded in seeing the aperture and columella very clearly. The inner lip is more thickened, and the margin at its base more effuse, and the aperture more angular there than as shown in the figure of the imperfect specimen represented by our fig. 6 *b*, plate v. I have had to establish a new genus for its reception, as it is certainly not a *Melania*, nor a *Tiara*, to which latter I at one time believed it might belong.

Locality and position.—Same as foregoing.

LIMNÆA NITIDULA, Meek.

Plate 5, fig. 14.

Melania ? nitidula, Meek (July, 1860), Proceed. Acad. Nat. Sci. Philad., 314.

Shell subovate; spire conical, moderately elevated; volutions about six and a half, rounded-convex, increasing rather gradually from the apex; suture well defined;

aperture subovate, narrowly rounded below and angular above, scarcely equaling half the entire length of the shell; surface marked by fine obscure lines of growth.

Length, 0.40 inch; breadth, 0.20 inch; apical angle convex, divergence about 40°.

This is a neat little shell, quite unlike any other species known to me from the Bear River beds. In several respects, it resembles some recent species, but it still differs too clearly to be confounded with any of them, even if its geological position did not preclude its identification with any existing species. The specimens do not show the columella very clearly, and I have not been able to see on it the characteristic fold of *Limnæa* quite satisfactorily; but, on re-examination, I am more inclined to believe that it belongs to that genus than to any of the Melanian groups.

Locality and position.—Bear River fresh-water beds, at mouth of Sulphur Creek, Wyoming.

Genus RHYTOPHORUS.

RHYTOPHORUS PRISCUS, Meek.

Plate 5, fig. 4, *a*, *b*.

Melampus priscus, Meek (July, 1860), Proceed. Acad. Nat. Sci. Philad., XII, 315.
Rhytophorus priscus, Meek (1872), in Hayden's Second Ann. Rep. U. S. Geol. Survey of the Territories, 399.

Shell oval, moderately thick; spire depressed-conical; whorls about five, convex or subangular, last one comparatively large, shouldered above, and tapering below the middle; suture well defined; surface marked by rather obscure lines of growth, and small, regular, vertical, or slightly oblique folds, which are distinct on the spire and the upper part of the body, but obsolete below; aperture narrow, angular above, and narrowly rounded below; outer lip apparently sharp, and without teeth or crenulations within; columella provided with one rather strong oblique fold below, and a much smaller less oblique one about half-way up the aperture.

Length, near 0.77 inch; breadth, 0.50 inch; apical angle nearly regular, divergence about 80°.

This shell is very unlike any other fossil yet known in any of the fresh-water or estuary deposits of the West or Northwest, and differs materially from any recent species of which I have any knowledge.

Since writing the above, I have proposed a new genus, *Rhytophorus*, for its reception.

Locality and position.—Fresh-water or estuary beds on Bear River, near mouth of Sulphur Creek, latitude 41° 12′ north, longitude 110° 52′ west; probably latest Cretaceous.

TERTIARY FOSSILS.

MOLLUSCA.

LAMELLIBRANCHIATA.

Genus UNIO, Retzius.

UNIO HAYDENI, Meek.

Plate 5, fig. 11, *a*, *b*.

Unio Haydeni (July, 1860), Proceed. Acad. Nat. Sci. Philad., XII, 312.

Shell under medium size, subelliptical, rather thin, moderately convex; extremities more or less regularly rounded, the posterior margin being sometimes obliquely subtruncated above, and more narrowly rounded below, than the other; basal border semi-elliptical in outline; dorsal side nearly straight along the middle; beaks very small, depressed nearly to a level with the dorsal margin, not eroded, and apparently without wrinkles, located about half-way between the middle and the anterior end; posterior umbonal slopes rather prominently rounded; surface smooth, or only showing obscure marks of growth.

Length, 1.65 inches; height, 1 inch; convexity, 0.60 inch.

The specimens of this species in the collection are not in a condition to show the hinge, though some casts of the interior retain impressions of the lateral teeth, which are comparatively long and straight. These casts also show the muscular impressions to be moderately deep, and the cavity of the beaks rather shallow.

In size and form, this species resembles *Unio nucalis*, Meek and Hayden, from near the Black Hills, Nebraska; but its beaks are less elevated, and not so gibbous; they also appear never to possess the small concentric wrinkles characterizing those of that species; and it seems likewise to be a thinner shell than *U. nucalis*. Some varieties of it resemble *Mya tellinoides*, Hall (Frémont's Rept., 307, plate 3, fig. 1), which is doubtless also a *Unio;* but they always differ from the figure cited in having less elevated beaks, and in being proportionally broader posteriorly. Named in honor of Dr. F. V. Hayden, who has brought many specimens of the species from the Far West. It seems to come from a formation that Dr. Hayden has called the Bridger group.

Locality and position.—Fresh-water Tertiary beds, near Fort Bridger, and south of there, at the base of Uintah Mountains, latitude 41° 40′ north, longitude 110° 10′ west.

Genus GONIOBASIS, Lea.

Goniobasis Simpsoni, Meek.

Plate 5, fig. 1, *a, b, c, d, e*.

Melania Simpsoni, Meek (July, 1860), Proceed. Acad. Nat. Sci. Philad., XII, 313.

Shell elongate-conical; spire attenuated and pointed; volutions about ten, flattened or more or less convex, increasing gradually in size, last one rounded below; suture sometimes linear, in other instances more strongly defined, in consequence of the greater convexity of the whorls; surface marked by fine lines of growth, and small, slightly-arched, vertical folds, which vary in size and regularity on different specimens, and are crossed by small, obscure, thread-like revolving lines; aperture ovate; columella moderately sinuous below; lip somewhat retreating above, and prominent below the middle.

Length, 0.78 inch; breadth, 0.30 inch; apical angle nearly or quite regular, divergence about 26°.

The surface-markings of this species vary considerably on different individuals. The small vertical folds are usually quite obscure or wanting on the lower volutions, but sometimes they are well defined even on the body-whorl; while in other instances they become nearly or quite obsolete on all parts of the shell. The fine thread-like revolving lines are generally equidistant, and number about seven to ten on each whorl of the spire. When well defined, they sometimes impart a slightly nodose character to the folds, particularly near the middle of each whorl. Very often these revolving lines, like the vertical folds, are obscure or quite obsolete, while on other specimens they are distinctly defined on all the volutions.

In most cases, the whorls are very nearly flat, but those of other individuals are more convex. It is possible that these two forms may belong to distinct species, but there are so many intermediate gradations in this respect that I am inclined to regard them as merely varieties of one species.

There are several quite similar forms among our recent Melanians, such for instance as *Goniobasis comma*, Conrad, and *G. athleta* of Anthony, from which, however, this species will be readily distinguished by obvious characters.

The specific name is given in honor of Capt. J. H. Simpson, Topographical Engineers, United States Army, commander of Utah Exploring Expeditions, &c. I am in doubt in regard to the relations of this shell to one of the forms described by Professor Hall in Frémont's Report. Indeed, from first to last, I have had, as it were, to grope in the dark in regard to the fresh-water fossils described in that report, on account of the brevity of the descriptions and unsatisfactory figures, together with the uncertainty of the exact localities from which they were obtained.

Locality and position.—Later Tertiary beds at Ham's Fork, northeast of Fort Bridger, latitude 41° 40′ north, longitude 110° 10′ west. Probably Miocene.

GONIOBASIS ARCTA, Meek.

Plate 5, fig. 5.

Melania arcta, Meek (July, 1860), Proceed. Acad. Nat. Sci. Philad., XII, 314.

Shell rather small, very slender, terete; volutions about twelve, flattened-convex, increasing very gradually from the apex; suture distinctly defined; surface showing an exceedingly slight tendency to develop moderately broad, rather distant, vertical folds, with faint traces of small revolving striæ; aperture ovate.

Length, 0.56 inch; breadth, 0.17 inch; apical angle regular, divergence 15°.

This shell I now rather regard as only a slender variety of the last-described species; but it differs so much from all the specimens I have seen certainly belonging to that variable shell, that, with the collections at hand for comparison, this cannot be clearly demonstrated. It is as much as one-third to one-half narrower, and has two or three whorls more than well-marked specimens of *M. Simpsoni* of its own length; while its whorls differ in being flattened more obliquely above.

The lower part of each whorl rounds abruptly into the suture below, so that the most prominent part is generally just above the suture. This prominence is also continued around the middle of the body-whorl.

Locality and position.—Same as last.

Genus PLANORBIS, Müller.

PLANORBIS SPECTABILIS, Meek.

Plate 5, fig. 7, *a*, *b*, *c*, *d*.

Planorbis spectabilis, Meek (July, 1860), Proceed. Acad. Nat. Sci. Philad., XII, 314.

Shell large, moderately compressed; upper side slightly convex, sometimes a little concave in the middle; periphery rather narrowly rounded below the middle; volutions five and a half, increasing gradually in size, wider than high, depressed-convex, and sloping a little outward above, distinctly convex below; about one-half of each inner whorl on the under side and less than one-fourth above embraced by each succeeding turn; umbilicus rather deep, and one-third wider than the outer whorl; surface and aperture unknown.

Greatest breadth, 1.19 inches; height, 0.25 inch.

This is a fine large species that seems to be quite abundant. It is often found much distorted by pressure, and in this way presents a great diversity of forms and appearances. It resembles several European Eocene and other Tertiary forms; but, so far as I have been able to make comparisons, it seems to be distinct from them all.

Locality and position.—Ham's Fork, in Southwestern Wyoming; from beds now (1875) known as the Green River group.

PLANORBIS SPECTABILIS, *var.* UTAHENSIS, Meek.

Plate 5, fig. 8, *a*, *b*, *c*.

Planorbis Utahensis, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 314.

This form differs from the typical *P. spectabilis* in having its volutions, and indeed the whole shell, more depressed, and its periphery more narrowly rounded; while its aperture is proportionally narrower and more oblique. Its volutions also seem to increase more rapidly in breadth. These differences are quite well enough marked to distinguish it specifically, if we could be entirely sure that they are not, partly at least, due to accidental distortion. The type-specimens have evidently been a little depressed by accidental pressure, but still seem to have been naturally more depressed. For the present, I have concluded to view this form as a variety of *P. spectabilis.*

Locality and position.—Same as last.

LIMNÆA VETUSTA, Meek.

Plate 5, fig. 3, *a*, *b*.

Limnœa vetusta, Meek (July, 1860), Proceed. Acad. Nat. Sci. Philad., XII, 314.

Shell elongate-subovate; spire rather slender and pointed; volutions five and a half to six, compressed or moderately convex; suture well defined; surface nearly smooth, with traces of fine lines of growth, scarcely visible without the aid of a lens; aperture narrow-ovate, apparently rather narrowly rounded below, and acutely angular above, equaling about half the entire length of the shell; columella with a small, comparatively straight, fold.

Length, 0.56 inch; breadth, 0.26 inch.

This and the following form are more like species occurring in the White River Tertiary basin than any yet known in other formations of the Northwest; but they both differ from the White River species in being more slender, in consequence of the less ventricose character of the body-whorl.

Locality and position.—Same as last.

LIMNÆA SIMILIS, Meek.

Plate 5, fig. 2, *a*, *b* (mag. 2 diam.).

Limnœa similis, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 314.

This form differs from the last in having more convex whorls and a deeper, as well as a more oblique suture. They may possibly be varieties of one species, but, after examining a more complete series than that first studied, I am still inclined to think them more probably distinct.

Locality and position.—Same as last.

CATALOGUE OF THE ORGANIC REMAINS CONTAINED IN THE COLLECTION.

DEVONIAN SPECIES.

BRACHIOPODA.

NAMES.	REMARKS, LOCALITIES, ETC.
Productus ———, undt. sp., No. 350*	West side of Buell Valley; latitude 39° 30′, longitude 115° 36′.
Athyris ———, undt. sp., No. 350	Locality and position same as last.
Atrypa aspera, (Schlot.) Dalm.?, No. 350	Locality and position same as last.
Atrypa reticularis, (Lin.) Dalm., No. 350	Locality and position same as last.
Spirifer ———, undt. sp., No. 350	Locality and position same as last.
Spirifer Utahensis, Meek	Locality and position same as last.
Spirifer strigosus, Meek, No. 351	Buell Valley; latitude 39° 32′, longitude 115° 36′.
Spirifer Engelmanni, Meek, No. 351	Buell Valley; latitude 39° 32′, longitude 115° 36′.
Undetermined fragments of trochiform univalves	Buell Valley; latitude 39° 32′, longitude 115° 36′.

CRUSTACEA.

Homalonotus? ——— (fragments)	West side of Steptoe Valley; latitude 39° 47′, longitude 114° 58′.
Prœtus ———, undetermined fragments	Locality and position same as last.

CARBONIFEROUS SPECIES.

PLANTÆ.

Lepidodendron ———, undt. sp., No. 144	In dark shaly beds, Timpanogos Cañon, Utah; latitude 40° 22′, longitude 111° 38′. *Coal-Measures.*
Stems or rootlets of undt. plants	In sandstone, 13 miles west of Leavenworth City, Kansas. *Coal-Measures.*

FORAMINIFERA.

Fusulina cylindrica, Fischer?	Nine miles west of Leavenworth City; east fork of Grasshopper Creek, and on Nemaha and Vermilion Creeks, Kansas. *Coal-Measures.*

POLYPI.

Chætetes ———, undt. sp., No. 402	Massive. Found loose near Rio Virgen; latitude 37°, longitude 114°. Age?
Syringopora ———, undt. sp., No. 184	Similar to *S. ramulosa*, Goldf. Western foot of General Johnston's Pass; latitude 40° 6′, longitude 112° 42′. Probably *Lower Carboniferous.*

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* These are the original numbers of the specimens.

Zaphrentis ———, undt. sp., No. 170	West of Camp Floyd, in hard, dark, siliceous limestone; latitude 40° 13′, longitude 112° 10′. *Lower Carboniferous.*
Cyathophyllum? ———, No. 185	West foot of General Johnston's Pass; latitude 40° 6′; longitude 112° 42′. *Lower Carboniferous.*

POLYZOA.

Fenestella ———, undt. sp. (fragments), No. 201	Hills west of Camp Floyd; latitude 40° 13′ longitude 112° 10′. *Lower Carboniferous.*
Archimedipora ———, undt. fragment, No. 201	Locality and position same as last.

BRACHIOPODA.

Chonetes Verneuiliana, N. and P., No. 243	Yellow limestone east side of Long Valley; latitude 39° 57′; longitude 115° 10′. *Upper Carboniferous.*
Productus multistriatus, Meek, No. 243	Locality and position same as last.
Productus ———, undt. sp., No. 243	Specimens imperfect; apparently resembling *P. Rogersi*, Norwood and Pratten, but more produced in front. Locality and position same as last.
Productus ———, undt. sp	None of the specimens well preserved. Of medium size; ventral valve gibbous, with a very distinct mesial sinus; smooth near the beak, with obscure radiating costæ, and scattering erect spines on the anterior and lateral slopes; scarcely any traces of concentric wrinkles; abundant. No. 360, Summit Spring; No. 243, west side Long Valley; No 246, pass east of Ruby Valley. All between latitude 39° 33′; longitude 115° 20′, and latitude 40°, longitude 115° 10′. *Upper Carboniferous.*
Productus ———, undt. sp	Specimens imperfect, all silicified; somewhat reticulated by the concentric wrinkles crossing the fine striæ on the visceral region; in hard, dark-colored limestone. No. 252, on east side of Buell Valley, latitude 39° 32′, longitude 115° 24′. Probably *Lower Carboniferous.*
Productus ———, undt. sp. (fragments)	Like *P. semireticulatus.* Siliceous, and in very hard, dark, siliceous limestone. Hills west of Camp Floyd; latitude 40° 13′; longitude 112° 10′. *Lower Carboniferous.*
Productus semistriatus, Meek, No. 144	In dark shaly beds, Timpanogos Cañon; latitude 40° 22′; longitude 111° 38′. *Coal-Measures.*
Productus ———, undt. sp	All fragments; very finely striate, and without concentric wrinkles. Locality and position same as last.
Productus æquicostatus, Shumard?	North Platte, 15 miles above Fort Laramie; also 2½ miles west of Clear Creek, Kansas. *Coal-Measures.*
Productus semireticulatus, Martin	Richmond, on Nemaha Creek, and on Big Blue River, Eastern Kansas. *Coal-Measures.*

Productus Rogersi, Norwood and Pratten	Four miles west of Fort Leavenworth, Kansas. *Coal-Measures.*
Productus Prattenanus, Norwood	Fragments. Near Clear Creek; on Grasshopper Creek, Kansas. *Coal-Measures.*
Orthis Michelini, (Léveillé) Koninck, No. 218	Pass between Desert and Pleasant Valley; latitude 39° 42′; longitude 113° 50′. *Lower Carboniferous.*
Hemipronites, undt. sp., No. 364	Like *H. crenistria*, but apparently more finely striate. Mountains east of Steptoe Valley; latitude 39° 15′; longitude 114° 45′. *Lower Carboniferous.*
Hemipronites crassus, Meek and Hayden	Two miles west of Clear Creek, Kansas Territory. *Coal-Measures.*
Hemipronites crenistria, Phillips, sp., No. 204	Hills west of Camp Floyd, latitude 40° 13′, longitude 112° 10′. *Lower Carboniferous.*
Rhynchonella ———, undt. sp., No. 185	Medium size, moderately gibbous, with three plications on the mesial fold and five on each side of it. Latitude 40° 6′; longitude 112° 42′. Probably *Lower Carboniferous.*
Athyris subtilita, Hall, sp., No. 244	West side of Long Valley, latitude 40°; longitude 115° 15′, in yellow limestone of the age of *Coal-Measures.* Larger specimens of apparently the same species were also found in the *same rock*, between Long and Ruby Valleys; likewise at Fort Leavenworth, Kansas Territory, in the *Coal-Measures.*
Athyris ———, one or two undt. sp	At Timpanogos Cañon; latitude 40° 20′, longitude 111° 42′. *Coal-Measures.*
Terebratula?, No. 244	Small, subglobose, or subovate; valves nearly equal, having a faint sinus near the front of the ventral valve, and a corresponding elevation in the other; surface marked by regular, moderately distinct lines of growth. West side of Long Valley; latitude 40°; longitude 115° 15′, in yellow limestone. *Coal-Measures.*
Terebratula?	Rather small, smooth, much more compressed than the last; ventral valve sinuous near the front. West of Camp Floyd; latitude 40° 13′, longitude 112° 10′. *Lower Carboniferous.*
Spiriferina pulchra, Meek, No. 243	East and west side of Long Valley; pass east of Ruby Valley; latitude 40°; longitude 115° 20′. *Upper Carboniferous.*
Spirifer scobina, Meek	Yellow limestone, divide between Long and Ruby Valleys; latitude 40°; longitude 115° 20′. *Upper Carboniferous.*
Spirifer cameratus, Morton	Second fork of Grasshopper Creek, Kansas. *Coal-Measures.*
Spirifer cameratus, var. *occidentalis*, No. 356	Summit of Spring Pass; east of Long Valley and between Long and Ruby Valleys; longitude 115° 12′ to 20′; latitude 39° 33′ to 40°. *Upper Carboniferous.*
Spirifer ———, undt. sp., No. 201	In hard, dark-colored limestone, west of Camp Floyd; latitude 40° 13′; longitude 112° 10′. *Lower Carboniferous.*

Spirifer ———, undt. sp., No. 364	Above medium size, smooth, width greater than length; hinge equaling greatest breadth; ventral valve with shallow, moderately distinct, rounded sinus. Gray granular limestone, mountains east of Steptoe Valley; latitude 39° 15′; longitude 114° 45′. Probably *Lower Carboniferous ?*.

LAMELLIBRANCHIATA.

Aviculopecten Utahensis, Meek, No. 359	Summit Spring; latitude39° 33′; longitude 115° 12′. Yellow-limestone series, *Upper Carboniferous.*
Aviculopecten, undt. sp. (fragments), No. 243	Large, regularly and distinctly plicated; plications simple, angular, and crossed by regular, distinct, concentric marks. East side of Long Valley; latitude 39° 57′; longitude 115° 10′. Position same as last.
Myalina ———, undt. sp	Specimens imperfect. Grasshopper Creek, Eastern Kansas. *Coal-Measures.*
Allorisma	Grasshopper Creek, and 2½ miles west of Clear Creek, Kansas. *Coal-Measures.*

GASTEROPODA.

Bellerophon ———, undt. sp. (casts)	Two and a half miles west of Clear Creek, Kansas. *Coal-Measures.*

CEPHALOPODA.

Nautilus ———, undt. sp., No. 201	Small, subdiscoidal; whorls somewhat embracing, rounded on the dorsum, and subangular around the middle of each side, increasing gradually in size. West of Camp Floyd; latitude 40° 13′; longitude 112° 10′. In dark limestone. *Lower Carboniferous.*
Nautilus ———, (undt. fragments), No. 359	Rather large, discoidal; volutions subquadrangular, and but slightly embracing. Yellow impure limestone, at Summit Spring; latitude 39° 33′; longitude 115° 12′. *Upper Carboniferous.*
Orthoceras baculum, Meek	East side of Ruby Valley.

PERMIAN FORMS ?.*

POLYZOA.

NAMES.	REMARKS, LOCALITIES, ETC.
Phyllopora ?, No. 145	Specimen silicified, and not in a condition to be determined without doubt. Timpanogos River; latitude 40° 35′; longitude 111° 30′.
Aviculopecten, undt. sp., No. 22	Cottonwood Creek, north side of Kansas River, Eastern Kansas, in yellow, impure magnesian limestone.

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* There is such a mingling of Permian and Coal-Measure types of fossils through a considerable thickness of rocks in Kansas and some other portions of the West, that it is very difficult to draw a line between these groups; consequently, it is not improbable that a portion, if not all, of the few specimens included in this Permian list, may have been obtained from beds below the horizon at which the line should be drawn between the Permian and Carboniferous systems.

Bakevellia?, No. 145	Fragments in hard siliceous rock. Timpanogos Valley; latitude 40° 35; longitude 111° 30′.
Bakevellia parva, Meek and Hayden	Casts in yellow, impure, magnesian limestone. Cottonwood Creek, north of Kansas River, Eastern Kansas.
Leda subscitula, Meek and Hayden	Locality and position same as last.
Leda ———, undt. sp	Similar to *L. bellastriata*, Stevens, but much smaller. Locality and position same as above.

GASTEROPODA.

Bellerophon ———, undt. sp	Near Big Blue River, Eastern Kansas.

JURASSIC SPECIES.

ECHINODERMATA.

NAMES.	REMARKS, LOCALITIES, ETC.
Pentacrinites asteriscus, M. and H., No. 130	East fork of Weber River; latitude 40° 48′; longitude 111° 15′. Also on the North Platte, near Red Buttes.
Pentacrinites ———, undt., No. 417	Portions of column. Near Red Buttes, North Platte; latitude 42° 50′; longitude 106° 40′.

LAMELLIBRANCHIATA.

Ostrea Engelmanni, Meek, No. 92	Near Red Buttes, on North Platte; latitude 42° 50′; longitude 106° 40′.
Gryphæa calceola, Quenstedt?	Locality and position same as above.
Camptonectes bellistriata, Meek	Locality and position same as above.

GASTEROPODA.

Dentalium? subquadratum, Meek	Locality and position same as above.

CEPHALOPODA.

Belemnites densus, Meek and Hayden	Locality and position same as above.

CRETACEOUS SPECIES.

LAMELLIBRANCHIATA.

NAMES.	REMARKS, LOCALITIES, ETC.
Ostrea congesta, Conrad, No. 85	North Platte above the bridge; latitude 42° 50′; longitude 106° 30′. No. 3 of the Upper Missouri section.
Ostrea ———, undt. sp. No. 156	Bear River, near the mouth of Sulphur Creek; latitude 41° 12′; longitude 110° 50′, from a yellowish sandstone.
Anomia concentrica, Meek	Locality and position same as last.
Inoceramus ———, undt. sp	This shell seems to be closely allied to a form described by Dr. Schiel, in the 2d vol. Pacific Railroad Reports, under the name *I. pseudomytiloides*. Locality and position same as above.
Inoceramus Simpsoni, Meek, No. 84	North Platte, above bridge; latitude 42° 50′; longitude 106° 30′. No. 3 of Upper Missouri section.

Inoceramus ———, undt. sp	Resembles *I. Mortoni*, Meek and Hayden (which holds a position near the base of formation No. 4 in Upper Missouri), but may be distinct. Found loose at or near the same locality as last.
Inoceramus pseudomytiloides, Schiel	Five miles east of Big Sandy, Eastern Kansas. No. 3 of Upper Missouri section.
Inoceramus aviculoides, Meek and Hayden	Locality and position same as last.
Panopœa ?	Apparently a *Panopœa;* but, as the specimens are merely imperfect casts and impressions left in the matrix, it is not possible to identify it with any known species. Above Deer Creek, on North Platte. Probably *Cretaceous.*
Baculites ———, undt. sp	Small and much compressed. Specimens imperfect. North Platte above the bridge, No. 3 of Upper Missouri *Cretaceous* series; also in same position five miles east of Big Sandy, Eastern Kansas.

FOSSILS OF THE BEAR RIVER FRESH- OR BRACKISH-WATER BEDS.

LAMELLIBRANCHIATA.

NAMES.	REMARKS, LOCALITIES, ETC.
Unio vetustus, Meek, No. 154	Near Bear River, on Sulphur Creek, in estuary beds; longitude 110° 52′; latitude 41° 12′.
Corbula (Anisorhynchus) pyriformis, Meek, No. 154	Bear River, same position.
Corbula Engelmanni, Meek, No. 154	Locality and position same as last.

GASTEROPODA.

Pyrgulifera humerosa, Meek, No. 154	Locality and position same as above.
Limnœa ? nitidula, Meek	Bear River, same as above.
Campeloma macrospira, No. 154	Locality and position same as above.
Viviparus Conradi, Meek and Hayden ? ?, No. 154	Locality and position as above.
Rhytophorus priscus, Meek	Same as above.

TERTIARY SPECIES.

LAMELLIBRANCHIATA.

NAMES.	LOCALITIES, ETC.
Unio Haydeni, Meek	Ham's Fork, southwestern Wyoming.

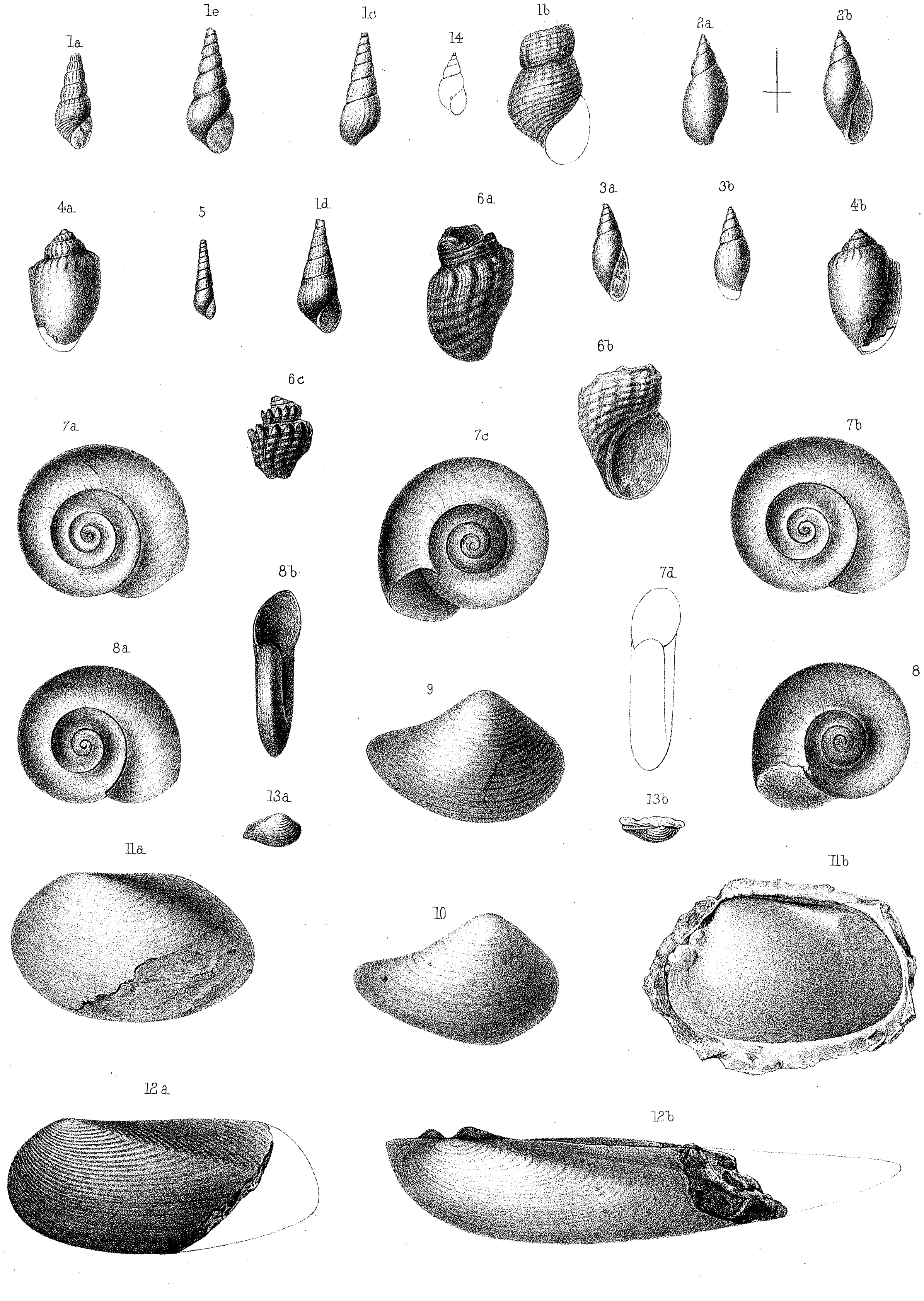
GASTEROPODA.

Goniobasis Simpsoni, Meek	Ham's Fork.
Goniobasis arcta, Meek	Ham's Fork.
Planorbis spectabilis, Meek	Ham's Fork.
Planorbis spectabilis, var. *Utahensis*, Meek	Ham's Fork.
Limnœa vetusta, Meek	Ham's Fork.
Limnœa similis, Meek	Ham's Fork.

PALÆONTOLOGY of
Capt. J. H. Simpson's Expls. 1858-59

TERTIARY FOSSILS.
with some Cretaceous? types.

Appendix J, Plate V.



J. J. Young. del.

T. Sinclair & Son. lith. Phila.

PLATE V.

Page.

Fig. 1. Goniobasis Simpsoni 365
- 1, *a*. Specimen with vertical costæ and revolving lines well defined.
- 1, *b*. Magnified view of a portion of the same.
- 1, *c*. View of a specimen with more flattened whorls and less distinct surface-markings.
- 1, *d*. Another view of the same, showing the aperture.
- 1, *e*. View of a specimen with more convex whorls and moderately distinct surface-markings.

Fig. 2. Limnæa similis 367
- 2, *a*. Back view of a specimen magnified two diameters.
- 2, *b*. Another view of the same.

Fig. 3. Limnæa vetusta 367
- 3, *a*. Front view, natural size.
- 3, *b*. Back view of same.

Fig. 4. *a*, *b*. Rhytophorus priscus, two views 364

Fig. 5. Goniobasis arcta, Meek 366

Fig. 6. Pyrgulifera humerosa 363
- 6, *a*. Dorsal view of an imperfect specimen.
- 6, *b*. Another view of the same. [Inner lip too thin and base of aperture too round.]
- 6, *c*. A smaller specimen with more distinct nodes around the shoulder.

Fig. 7. Planorbis spectabilis 366
- 7, *a*, *b*. Upper views of two specimens.
- 7, *c*. Under view of the former.
- 7, *d*. Profile view.

Fig. 8. Planorbis spectabilis *var.* Utahensis 367
- 8, *a*. Upper view.
- 8, *b*. Profile view, showing aperture.
- 8, *c*. Under side, showing umbilicus.

Figs. 9 and 10. Corbula pyriformis 361

Fig. 11. Unio Haydeni 364
- 11, *a*. Specimen retaining most of the shell.
- 11, *b*. Internal cast.

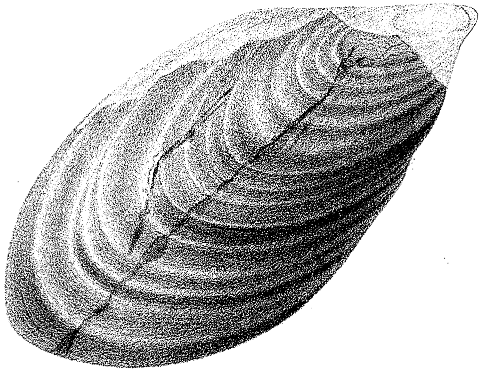
Fig. 12. Unio vetusta 361
- 12, *a*. Side view of an imperfect young shell, flattened by pressure.
- 12, *b*. Dorsal view of a large left valve, the posterior portion of which is broken away.

Fig. 13. Corbula Engelmanni 362
- 13, *a*. Side view of right valve.
- 13, *b*. Dorsal view of same.

Fig. 14. Limnæa? nitidula 363

CRETACEOUS FOSSILS.

1a



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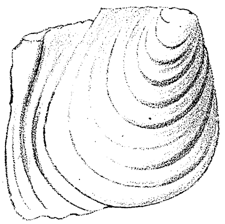

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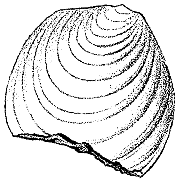

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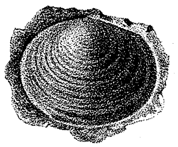

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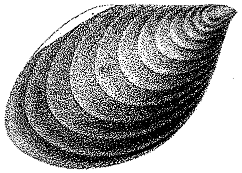

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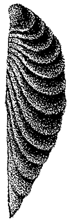

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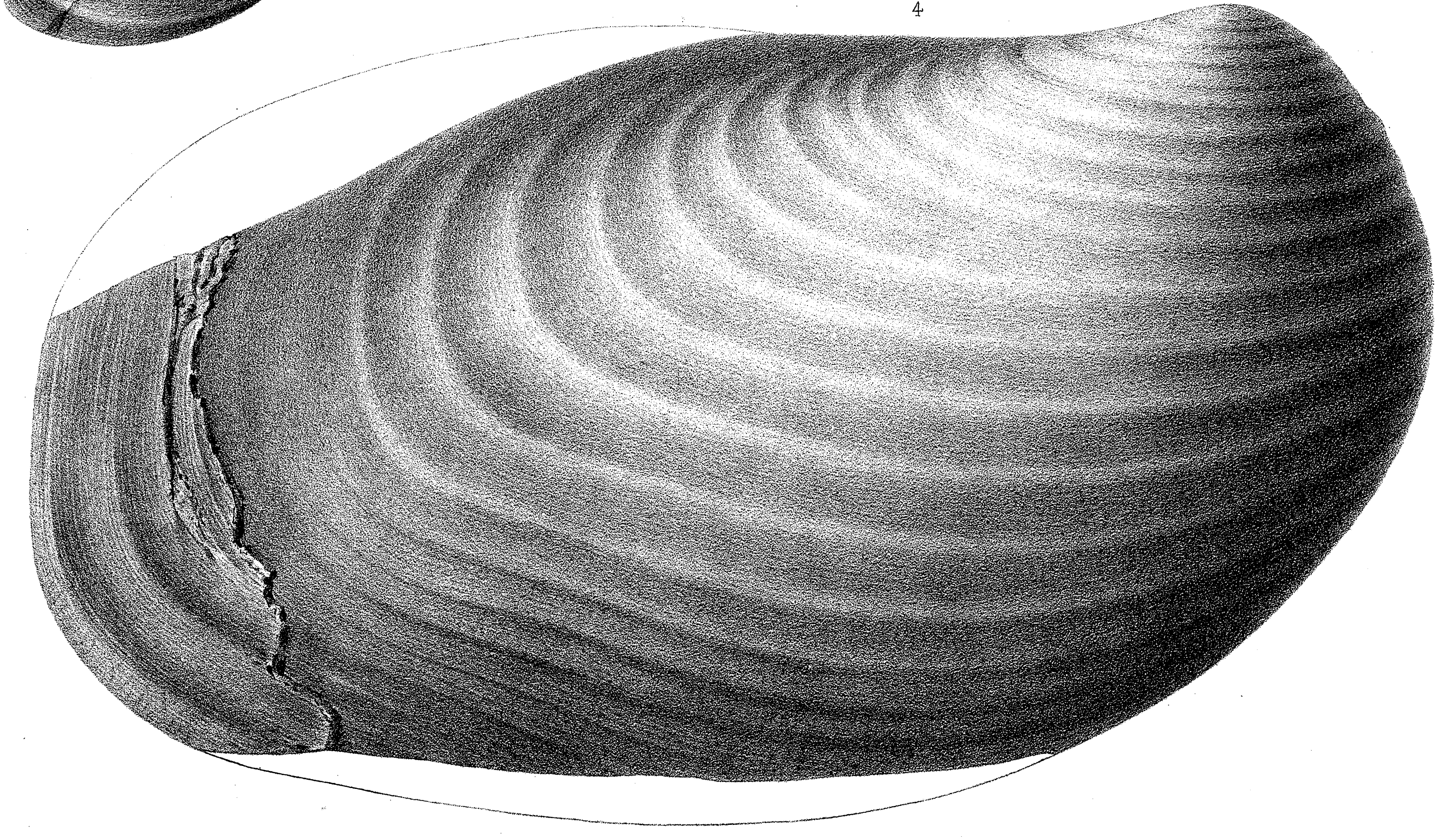


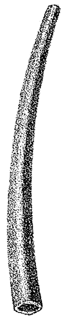
Mrs. Myers. del.

T. Sinclair & Son. lith. Phila.

PLATE IV.

	Page.
Fig. 1, *a*. Inoceramus problematicus?	358
a. Side view of a specimen, with irregular undulations.	
1, *b* and *c*. Inoceramus dimidius?	358
Fig. 2, *a* and *b*. Inoceramus ———, undt	358
Fig. 3. Anomia concentrica, upper valve in matrix	359
Fig. 4. Inoceramus Simpsoni	360
A right-side view of type specimen, natural size.	

JURASSIC FOSSILS.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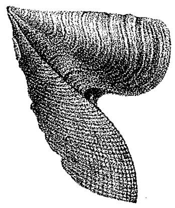
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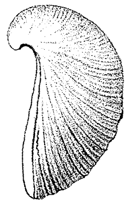
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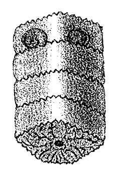
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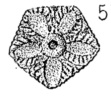
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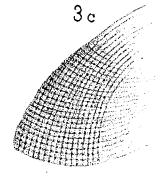
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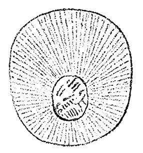
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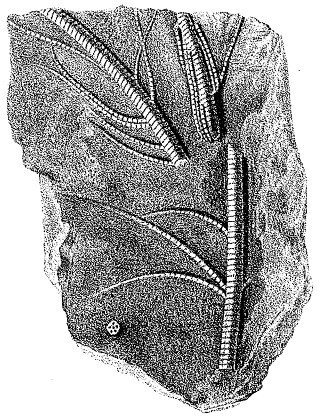
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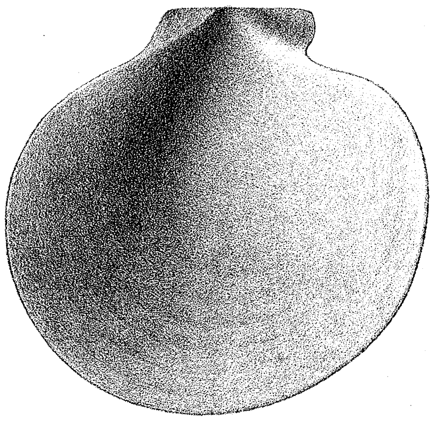
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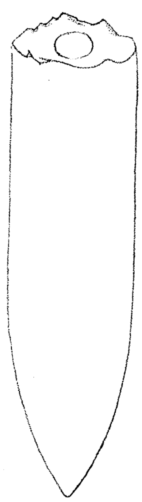
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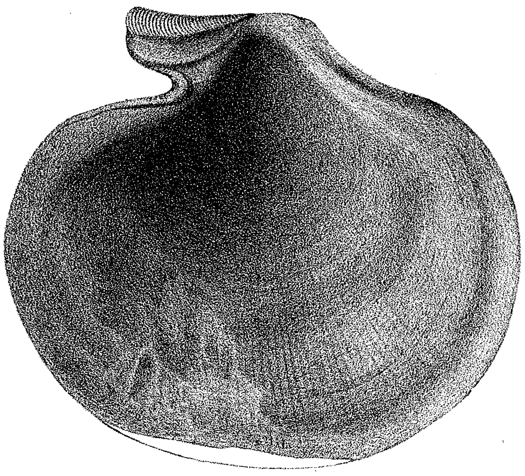
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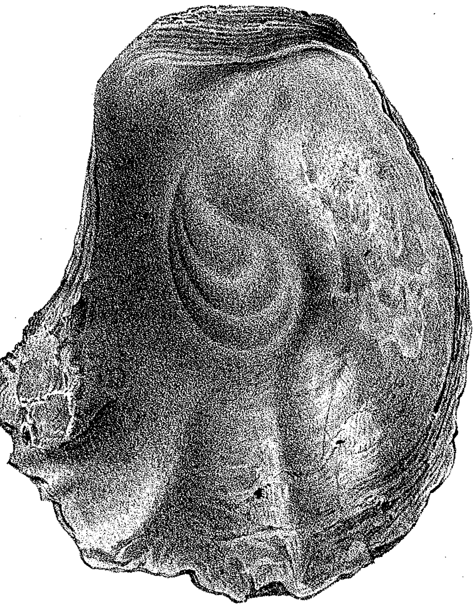
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J. J. Young, del.

T. Sinclair & Son, lith. Phila.

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CARBONIFEROUS FOSSILS.

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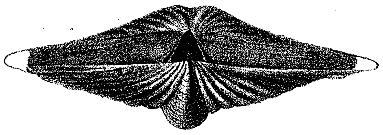
1a



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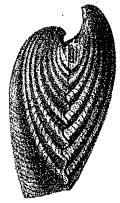

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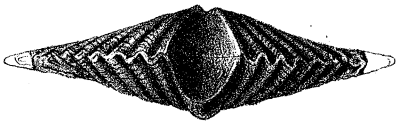

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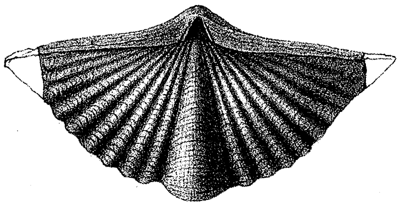

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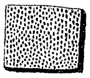

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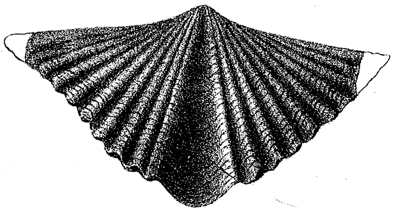

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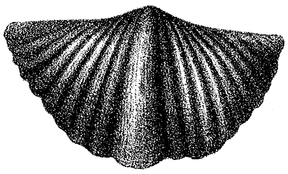

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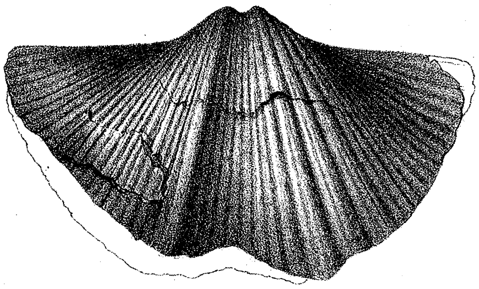

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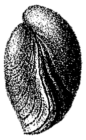

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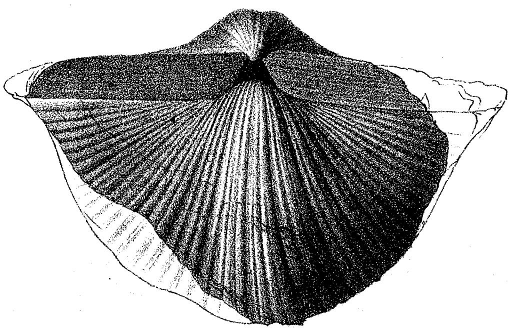

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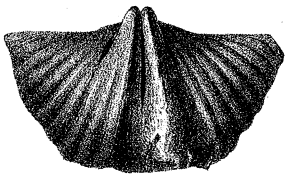

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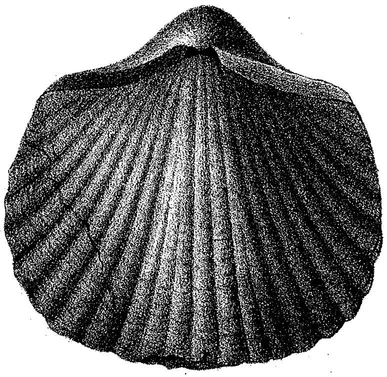

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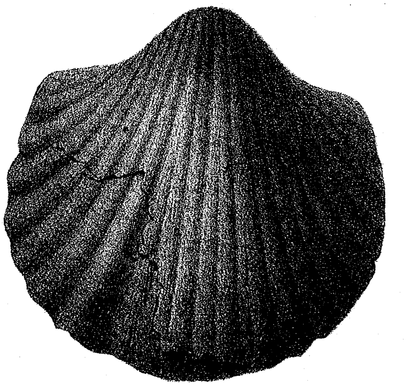

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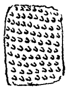

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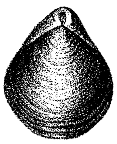

J. J. Young, del.

T. Sinclair & Son. lith. Phila.

PLATE II.

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Fig. 1. SPIRIFERINA PULCHRA 352

1, *a*. Hinge and area view.
1, *b*. Side view.
1, *c*. Front view.
1, *d*. Dorsal view.
1, *e*. Ventral view.
1, *f*. Dorsal view of an internal cast.
1, *g*. Ventral view of the same.
1, *h*. Punctured external surface magnified.

Fig. 2. CHONETES VERNEUILIANA, *var.* UTAHENSIS 348

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Fig. 3. SPIRIFER CAMERATUS? 353

3, *a*. Ventral view.
3, *b*. Dorsal view.

Fig. 4. ATHYRIS SUBTILITA 350

4, *a*. Side or profile view.
4, *b*. Dorsal view.

Fig. 5. SPIRIFER SCOBINA 351

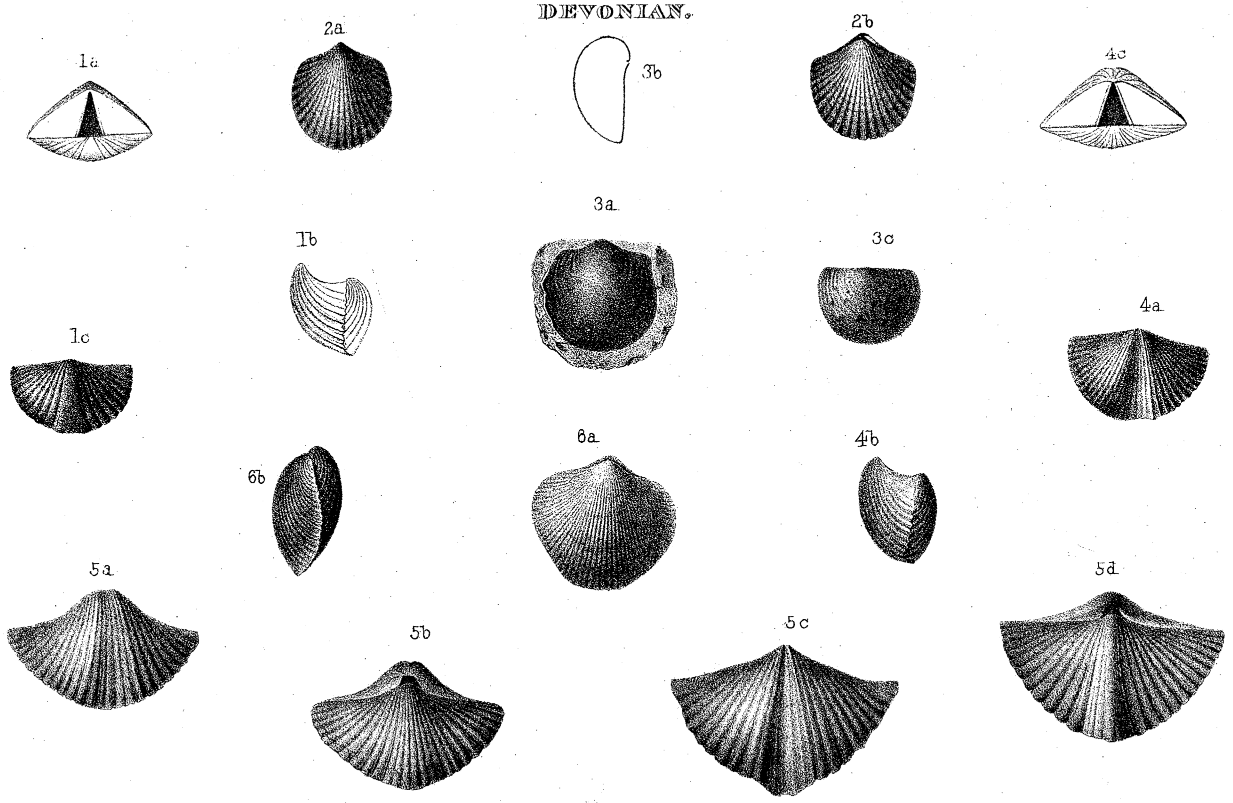
5, *a*. Dorsal view.
5, *b*. Ventral view.
5, *c*. Portion of granulated surface magnified.

PALAEONTOLOGY of
Capt. J.H. Simpson's
Expls. 1858-59.

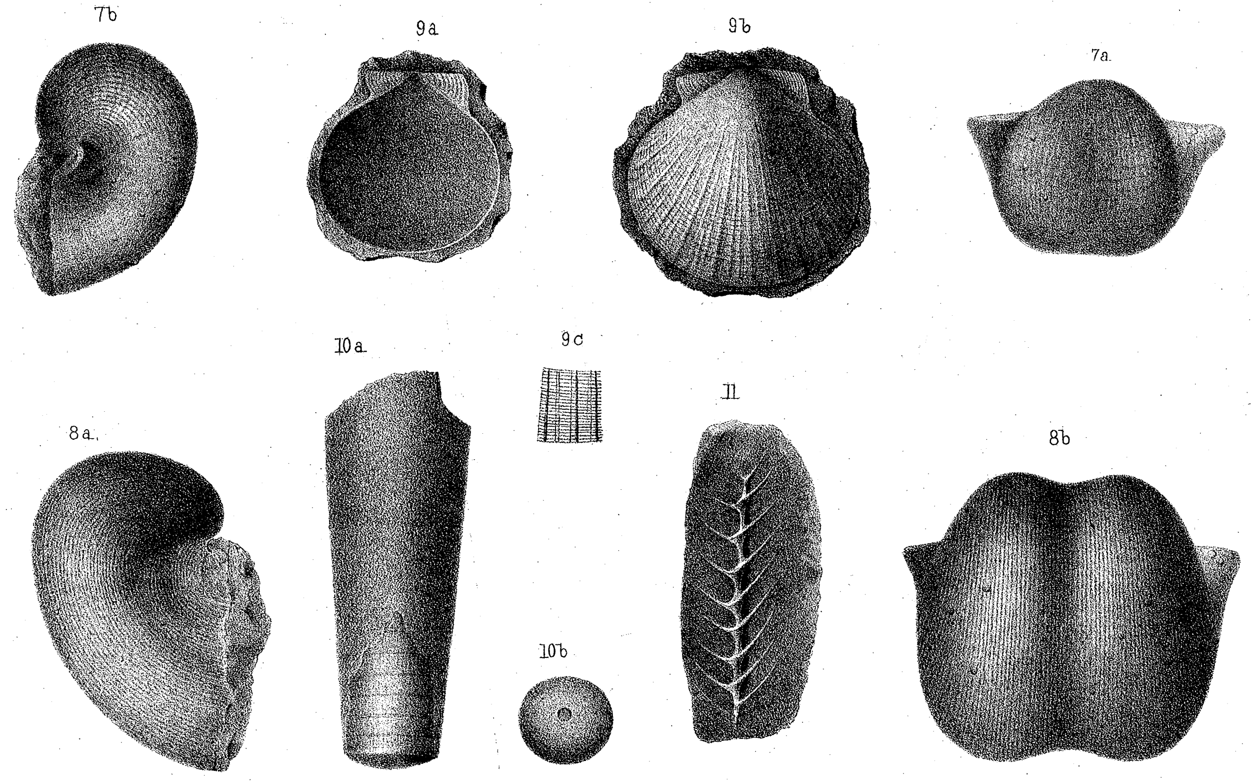
DEVONIAN & CARBONIFEROUS FOSSILS.

Appendix J. Plate I.

DEVONIAN.



CARBONIFEROUS,



J. Young. del.

T. Sinclair & Son, lith. Phila.

PLATE I.

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Fig. 1. Spirifer Engelmanni 346
- 1, *a*. Outline showing the form of the area and foramen.
- 1, *b*. A side view.
- 1, *c*. Dorsal view.

Fig. 2. Atrypa aspera? 348
- 2, *a*. Ventral view.
- 2, *b*. Dorsal view.

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- 3, *a*. Ventral valve.
- 3, *b*. An outline side view of same.
- 3, *c*. Dorsal valve.

Fig. 4. Spirifer Utahensis 345
- 4, *a*. Ventral view.
- 4, *b*. Profile view.
- 4, *c*. Outline showing area and foramen.

Fig. 5. Spirifer strigosus 347
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- 5, *b* and *d*. Dorsal views of same.

Fig. 6. Atrypa reticularis 347
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- 6, *b*. Side view of same.

Fig. 7. Productus semistriatus 349
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- 7, *b*. Dorsal view of same.

Fig. 8. Productus multistriatus 350
- 8, *a*. A side view.
- 8, *b*. Ventral view of same.

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- 9, *b*. Outside view of left valve of a larger individual.
- 9, *c*. Magnified bit of the shell showing the fine concentric striæ of the surface.

Fig. 10. Orthoceras baculum 354
- 10, *a*. Specimen with a portion of the shell removed so as to show the septa.
- 10, *b*. End view of same, showing position of the siphuncle.

Fig. 11. Archimedipora ——? 348

APPENDIX K.

ORNITHOLOGY.

A LIST OF BIRDS

BY

PROF. SPENCER F. BAIRD.

APPENDIX K.

LIST OF BIRDS COLLECTED BY CHARLES S. McCARTHY, TAXIDERMIST.

Classified by Prof. Spencer F. Baird.

1. Falco saker var. polyagrus, *Ridgway.*—Prairie Falcon. South Fork Platte; between Butte and Steptoe Valleys; 2 specimens.

2. Tinnunculus sparverius, *Vieillot.*—Sparrow Hawk. Little Sandy River; Scott's Bluff; 27 miles west of Laramie; North Fork Platte; 4 specimens.

3. Accipiter fuscus, *Bon.*—Sharp-shinned Hawk. Big Sandy Creek; 1 specimen.

4. Buteo Swainsoni, *Bon.*—Swainson's Buzzard. Bear River, Utah; McCarthy's Creek; Ko-bah Valley; Sweetwater; 4 specimens.

5. Archibuteo ferrugineus, *Gray.*—Squirrel Hawk. Ko-bah Valley; Needles Creek; Sulphur Creek; 3 specimens. Also eggs Nos. 2329, 2330, in Rush Valley and South Fork Humboldt.

6. Circus hudsonius, *Vieillot.*—Marsh Hawk. Camp Floyd; Turnley's Spring; Bear River, Utah; 4 specimens. Eggs No. 2331, South Fork Humboldt.

7. Aquila chrysaëtos var. canadensis, *Ridgway.*—Golden Eagle. Steptoe Valley; 1 specimen.

8. Otus vulgaris var. wilsonianus, *Allen.*—Long-eared Owl. Skull Valley; 1 specimen. Eggs No. 2332 same place.

9. Brachyotus palustris, *Bonap.*—Short-eared Owl. Round Prairie; 1 specimen.

10. Speotyto cunicularia var. hypugæa, *Coues.*—Prairie Owl. Fort Kearney; Platte Creek; Horse Creek, Utah; 4 specimens.

11. Picus villosus var. harrisii, *Allen.*—Harris's Woodpecker. Utah; 1 specimen.

12. Melanerpes erythocephalus, *Swainson.*—Red-headed Woodpecker. Three from La Bonté River; 1 from Fort Leavenworth; 1 Utah; 5 specimens.

13. Melanerpes torquatus, *Bon.*—Lewis's Woodpecker. Sierra Nevada; 1 specimen.

14. Colaptes auratus, *Swainson.*—Flicker. Fort Leavenworth; 2 specimens.

15. Colaptes mexicanus, *Swainson.*—Red-shafted Flicker. North Fork Platte; La Bonté River; 2 specimens.

16. Selasphorus platycercus, *Gould.*—Broad-tailed Hummingbird. No labels; 3 specimens.

17. ANTROSTOMUS NUTTALII, *Cassin.*—"Poor Will." Smith's Creek; 1 specimen. Also eggs No. 2834, Ko-bah Valley.

18. CHORDEILES POPETUE var. HENRYI, *Allen.*—Western Night Hawk. Big Blue; La Bonté River; 2 specimens. Eggs No. 2333, Ko-bah Valley.

19. TYRANNUS VERTICALIS, *Say.*—Arkansas Flycatcher. Ruby Valley; La Bonté, Platte, and Humboldt Rivers; 4 miles west of Laramie; 6 specimens.

20. MYIARCHUS CINERASCENS, *Lawrence.*—Ash-throated Flycatcher. Valley of Humboldt River; Ko-bah Valley; 2 specimens.

21. EMPIDONAX PUSILLUS?, *Cabanis.*—Little Flycatcher. Goshoot Pass; 1 specimen.

22. EMPIDONAX OBSCURUS, *Baird.*—Wright's Flycatcher. Ruby Valley; Steptoe Valley; 2 specimens. Eggs (?) No. 2335, Dodge Valley.

23. TURDUS MIGRATORIUS, *Linnæus.*—Robin. Camp Floyd; mountains near Genoa; 3 specimens.

24. SIALIA MEXICANA, *Swainson.*—Western Bluebird. Sierra Nevada; Sweetwater; 2 specimens.

25. SIALIA ARCTICA, *Swainson.*—Rocky Mountain Bluebird. Ruby Valley, Utah; 4 specimens.

26. GEOTHLYPIS TRICHAS, *Cabanis.*—Maryland Yellowthroat. Fort Leavenworth; 1 specimen.

27. ICTERIA VIRENS var. LONGICAUDA, *Coues.*—Yellow-breasted Chat. Leavenworth; 1 specimen.

28. HELMINTHOPHAGA CELATA, *Baird.*—Orange-crowned Warbler. Green River; 1 specimen.

29. SEIURUS NOVEBORACENSIS, *Nutt.*—Water Thrush. Leavenworth; 1 specimen.

30. DENDROICA NIGRESCENS, *Baird.*—Black-throated Gray Warbler. Utah; 1 specimen.

31. DENDROICA AUDUBONII, *Baird.*—Audubon's Warbler. Utah; 1 specimen.

32. DENDROICA PENNSYLVANICA, *Baird.*—Chestnut-sided Warbler. Leavenworth; 1 specimen.

33. DENDROICA ÆSTIVA, *Baird.*—Summer Yellow Warbler. Fort Leavenworth; Ko-bah Valley, Utah; 3 specimens.

34. MYIODIOCTES PUSILLUS, *Bon.*—Green Black-capped Flycatcher. Leavenworth; Green River; 2 specimens.

35. PETROCHELIDON LUNIFRONS, *Say.*—Cliff Swallow. McCarthy's Creek; 2 specimens.

36. PROGNE SUBIS, *Baird.*—Purple Martin. 27 miles west of Laramie; 1 specimen.

37. COLLURIO BOREALIS, *Baird.*—Great Northern Shrike. Fort Laramie; Camp Floyd; 3 specimens.

38. COLLURIO LUDOVICIANUS var. EXCUBITOROIDES, *Coues.*—White-rumped Shrike. Steptoe Valley; Ko-bah Valley; Fort Laramie; between Long and Ruby Valleys; 4 specimens. Also eggs 2336, 2337, 2338, from Humboldt River, Utah.

39. GALEOSCOPTES CAROLINENSIS, *Gray*, Cabanis.—Catbird. Fort Leavenworth; 1 specimen.

40. Oreoscoptes montanus, *Baird.*—Mountain Mockingbird. Ko-bah Valley; South Fork Humboldt; 4 specimens. Also eggs Nos. 2340, 2341, 2342, 2343, 2344, from Ko-bah Valley, Utah; Antelope Valley; South Fork of Humboldt.

41. Harporhynchus rufus, *Cab.*—Brown Thrush. Leavenworth; 1 specimen.

42. Troglodytes aëdon var. parkmanii, *Coues.*—Parkman's Wren. La Bonte River; Sierra Nevada; 2 specimens.

43. Parus atricapillus var. septentrionalis, *Allen.*—Long-tailed Chickadee. Fort Leavenworth; 1 specimen.

44. Eremophila alpestris, *Boie.*—Sky Lark. Camp Floyd; 5 specimens.

45. Chrysomitris tristis, *Bon.*—Yellowbird. Fort Leavenworth; 1 specimen.

46. Pooecetes gramineus var. confinis, *Baird.*—Grass Finch. The eggs No. 2346 were collected at Antelope Peak.

47. Chondestes grammaca, *Bon.*—Lark Finch. Steptoe Valley; Forks of Platte; 2 specimens.

48. Junco oregonus, *Sclater.*—Oregon Snowbird. Camp Floyd; 1 specimen.

49. Spizella socialis, *Bon.*—Chipping Sparrow. Gibralter Creek; 1 specimen.

50. Spizella breweri, *Cassin.*—Brewer's Sparrow. Ko-bah Valley; Goshoot Pass; 3 specimens. Also eggs No. 2348, at Pilot Valley.

51. Spizella ——— ?.—McCarthy's Valley; Green River.

52. Passerella schistacea, *Baird.*—Slate-colored Sparrow. Mount Lookout; 1 specimen.

53. Calamospiza bicolor, *Bon.*—Lark Bunting. South Fork Platte; Chimney Rock; Utah; 3 specimens.

54. Euspiza americana, *Bon.*—Black-throated Bunting. Fort Kearney; Utah; 2 specimens.

55. Hedymeles melanocephalus, *Caban.*—Black-headed Grosbeak. 2 from Simpson's Lake; 2 from between Skull and Rush Valleys; 4 specimens.

56. Cyanospiza amœna, *Baird.*—Lazuli Finch. 2 Sierra Nevada; 1 Gibralter Creek; 3 specimens.

57. Cyanospiza cyanea, *Baird.*—Indigobird. Fort Leavenworth; 2 specimens.

58. Pipilo erythrophthalmus, *Vieillot.*—Towhee Bunting. Fort Leavenworth; 2 specimens.

59. Pipilo maculatus var. arcticus, *Coues.*—Arctic Towhee. La Bonté River; 1 specimen.

60. Pipilo chlorurus, *Baird.*—Green-tailed Finch. Mount Lookout, Utah; 2 specimens. Also eggs No. 2338, from same place.

61. Dolichonyx oryzivorus var. albinucha, *Ridgway.*—"Bob-o-link"—Reedbird. 115 miles west of Fort Kearney; 4 specimens.

62. Molothrus ater, *Gray.*—Cowbird. 115 miles west of Fort Kearney; 2 specimens.

63. Agelaius phœniceus, *Vieillot.*—Red-winged Blackbird. Utah; 3 from Camp Floyd; Platte River; 5 specimens.

64. Xanthocephalus icterocephalus, *Baird.*—Yellow-headed Blackbird. Bear River; South Fork of Platte; Chimney Rock; 3 specimens.

65. STURNELLA MAGNA var. NEGLECTA, *Coues.*—Western Lark. Big Blue River; Ruby Valley; 2 specimens.

66. ICTERUS BULLOCKI, *Bon.*—Bullock's Oriole. La Bonté River; Sierra Nevada; 2 specimens.

67. QUISCALUS PURPUREUS var. ÆNEUS, *Ridgway.*—Crow Blackbird. Fort Leavenworth; 1 specimen.

68. CORVUS CORAX var. CARNIVORUS, *Baird.*—American Raven. Camp Floyd; 2 specimens. Also eggs No. 2514, Pleasant Springs.

69. PICICORVUS COLUMBIANUS, *Bon.*—Clarke's Crow. Sierra Nevada; Fort Bridger; 2 specimens.

70. PICA RUSTICA var. HUDSONICA, *Baird.*—Magpie. Sweetwater; Carson Valley; 2 specimens.

71. CYANURA STELLERI var. FRONTALIS, *Ridgway.*—Steller's Jay. Sierra Nevada; 1 specimen.

72. CYANOCITTA CALIFORNICA var. WOODHOUSII, *Baird.*—Woodhouse's Jay. 2 Camp Floyd; Mount Lookout; Skull Valley; 4 specimens.

73. PERISOREUS CANADENSIS var. CAPITALIS, *Baird.*—Canada Jay. Utah; 1 specimen.

74. ECTOPISTES MIGRATORIA, *Sw.*—Wild Pigeon. 40 miles west of Fort Laramie; 1 specimen.

75. ZENAIDURA CAROLINENSIS, *Bon.*—Common Dove. Steptoe and Ko-bah Valleys; North Fork of Platte; 3 specimens.

76. CANACE OBSCURA, *Baird.*—Dusky Grouse. Little's Cañon; 1 specimen.

77. CENTROCERCUS UROPHASIANUS, *Sw.*—Sage Cock. 2 Little's Cañon; 2 Pacific Springs; 1 Camp Floyd; 1 Ko-bah Valley; 2 no labels; 8 specimens. Also eggs Nos. 2510, 2511, 2512, from South Fork of Humboldt, and Steptoe Valley.

78. PEDIOCÆTES PHASIANELLUS var. COLUMBIANUS, *Coues.*—Sharp-tailed Grouse. 100 miles from Fort Laramie; 1 specimen.

79. CUPIDONIA CUPIDO, *Baird.*—Prairie Hen. Fort Kearney; 1 specimen.

80. BONASA UMBELLUS var. UMBELLOIDES, *Baird.*—Gray Mountain Grouse. Utah; Fort Bridger; 2 specimens.

81. GRUS CANADENSIS, *Temminck.*—Sand-hill Crane. Humboldt Valley; Simpson's Lake; 2 specimens. Also eggs Nos. 2516, 2517, same localities.

82. BATAURUS MINOR, *Boie.*—Bittern. Marsh near Platte; 1 specimen.

83. NYCTIARDEA GRISEA var. NÆVIA, *Allen.*—Night Heron. Reese's River; 1 specimen. Eggs No. 2515, same place.

84. IBIS GUARAUNA, *Ridgway.*—Glossy Ibis. Simpson's Lake; 1 specimen.

85. ÆGIALITIS VOCIFERUS, *Cassin.*—"Killdeer." Horse Creek; Fort Kearney; 3 specimens.

86. ÆGIALITIS MONTANUS, *Baird.*—Mountain Plover. Horseshoe Creek; South Fork of Platte; Sweetwater; 3 specimens.

87. RECURVIROSTRA AMERICANA, *Gm.*—American Avocet. 4 from Sweetwater; Willet Camp; Avocet Camp; Horse Creek; 7 specimens.

88. STEGANOPUS WILSONII, *Coues.*—Wilson's Phalarope. Steptoe Valley; 10 miles from South Fork of Platte; 3 specimens.

89. Gallinago gallinaria var. wilsoni, *Ridgway.*—English Snipe. Fort Bridger; 1 specimen.

90. Tringa ———?.—30 miles west of O'Fallon's Bluff; 1 specimen.

91. Ereunetes pusillus, *Cassin.*—Semipalmated Sandpiper. Horse Creek; 1 specimen.

92. Symphemia semipalmata, *Hartl.*—Willet. Big Sandy River; 3 specimens.

93. Tringoides macularius, *Gray.*—Spotted Sandpiper. Simpson's Lake; 1 specimen.

94. Actiturus bartramius, *Bon.*—Field Plover. 5 specimens, all from Big Blue River.

95. Numenius longirostris, *Wilson.*—Long-billed Curlew. Utah; Camp Floyd; Carson Lake; O'Fallon's Bluff; Vermillion Creek; 5 specimens. Also eggs 2507, 2508, from Skull Valley; 2509 from South Fork of Humboldt.

96. Rallus virginianus, *Linn.*—Virginia Rail. Ko-bah Valley; 1 specimen.

97. Fulica americana, *Gm.*—Coot. Camp Floyd; 1 specimen.

98. Anas boschas, *Linn.*—Mallard. Big Sandy; 1 specimen. Eggs 2513, Ruby Valley.

99. Dafila acuta, *Jenyns.*—Pintail. Utah; Scott's Bluff; Sweetwater; Camp Floyd; 4 specimens.

100. Nettion carolinensis, *Baird.*—Green-winged Teal. 2 Utah Lake; Fort Kearney; 3 specimens.

101. Querquedula discors, *Steph.*—Blue-winged Teal. Utah; Fort Bridger; Sweetwater; 3 specimens.

102. Querquedula cyanoptera, *Cassin.*—Red-breasted Teal. 2 Spring Valley; Sweetwater; 3 specimens.

103. Spatula clypeata, *Boie.*—Shoveler. Utah; Utah Lake; Pilot Valley; South Fork of Platte; 4 specimens.

104. Chaulelasmus streperus, *Gray.*—Gadwall. Utah Lake; 2 specimens.

105. Mareca americana, *Steph.*—American Widgeon. Camp Floyd; 2 specimens.

106. Aix sponsa, *Boie.*—Summer Duck. Rock Creek, Kansas; 1 specimen.

107. Fulix affinis, *Baird.*—Little Blackhead. Lake Utah; 1 specimen.

108. Aythya americana, *Bon.*—Redhead. Lake Utah; 2 specimens.

109. Erismatura rubida, *Bon.*—Ruddy Duck. Utah; Sweetwater; 2 specimens.

110. Mergus americanus, *Cassin.*—Shelldrake. Utah; 1 specimen.

111. Lophodytes cucullatus, *Reich.*—Hooded Merganser. Fort Kearney; 2 specimens.

112. Sterna hirundo, *Linn.*—Wilson's Tern. Sweetwater; Horse Creek; 2 specimens.

113. Sterna fosteri, *Nuttall.*—Foster's Tern. Ruby Valley; 1 specimen.

114. Podiceps auritus var. californicus, *Coues.*—American Eared Grebe. East side Rocky Mountains; Sweetwater; 2 specimens.

Total of specimens, 258; total of species, 114.

APPENDIX L.

REPORT ON ICHTHYOLOGY.

BY

PROF. THEO. GILL.

APPENDIX L.

REPORT ON ICHTHYOLOGY.

By Prof. Theo. Gill.

Smithsonian Institution,
Washington, December 1, 1860.

Sir: I have the honor to forward to you the report on the ichthyology of your expedition, which I have been requested to prepare.

Although few species of fishes were obtained, they are of much interest. Most of them have been fully described in the accompanying report, even when not new, as in the case of the species which is now called *Platygobio communis.* As all the groups to which the respective species belong are in some confusion and not well restricted, I have been compelled to examine the history and nomenclature of not only the genera to which they are referable, but of the allied ones. As in almost all the cases, such genera have been limited in a different manner and considerable modifications introduced, I have always given the full generic characters, founded on a personal examination, or a careful perusal of the descriptions of all the known species of the genera. This I have considered to be the course most advantageous, under the circumstances, to science.

The classification which I have here followed is that which I have proposed and published in the Proceedings of the Academy of Natural Sciences of Philadelphia. It may be considered a modification of that of the illustrious and learned Johannes Müller, whose recent death has been so much mourned by naturalists; it differs from the Müllerian classification in the very different acceptation and restriction of the orders and suborders.

The investigations which have been undertaken in the preparation of the report have been pursued in the Smithsonian Institution; and to the power of availing myself of the excellent Library and Museum of the Institution, such value as the report may have is due.

I am, sir, very truly yours,

Theo. Gill.

Capt. J. H. Simpson.

Subclass TELEOSTEI, Müller.

Order TELEOCEPHALI, Gill.

Suborder PHYSOCLYSTI, (Bon.) Gill.

Family PERCOIDÆ, (Cuv.) Gill.

Subfamily LABRACINÆ, Gill.

There is found in the Mediterranean Sea a fish which has, from the earliest times, attracted the attention of the inhabitants of the neighboring coasts from the abundance in which it is found and the size to which it attains. By the ancients, as at the present day, it was much esteemed as an article of food, and was called by the Greeks λάβραξ, and by the Romans *lupus*. Of this fish, Cuvier has said (but scarcely with strict correctness) that its appearance and almost all the details of its form recall to mind the *perch*, and that a just idea would be given of it by describing it as a "*large, elongated, and silvery perch*".

From the *Perches*, however, it differs in several characters, which induced Cuvier to separate it generically, and for the name of the genus he adopted the Greek designation of the species. The characters by which Cuvier distinguished it from the Perches were the presence of teeth on the tongue and of two spines to the operculum. It differs also from the true Perches in the armature of some of its bones and by the shorter spinous dorsal fin, the rays in the European and allied American species being always nine, and still more by modifications of the skeleton and among others the small number of vertebræ, of which there are 11 or 12 abdominal and 13 or 14 caudal. The very distinct type represented by *Labrax Japonicus* Cuv. and Val. (=*Lateolabrax Japonicus* Bleeker) has, however, 16 abdominal and 19 caudal vertebræ.

Though Cuvier was the first to properly distinguish the genus, its type had been long previously recorded by Klein as the first of two species, which he placed in a group, for which he used the same name *Labrax*.

That author, in his fifth and last Missal for the Advancement of the Natural History of Fishes,* has devoted his ninth fasciculus to the consideration and description of those fishes provided with two dorsal fins. In this group he includes the Trouts (*Trutta* Klein), in which the first dorsal is sustained by branched rays while the second is adipose, as well as *Mullus*, *Cestræus* Klein, *Labrax* Klein, *Sphyræna*, *Gobio* Klein, *Asperulus* Klein, and *Trichidion* Klein, in which the first dorsal is spinous and the second has branched rays. *Trutta* of Klein is synonymous with the extended genus *Salmo* of Linnæus; *Mullus* embraces, like the Linnæan genus, the *Mulli* and the *Amias* of Gronovius, or *Apogons* of Lacépède; the *Cestræi* are the *Mugiles* of Linnæus; *Sphyræna* is limited to the true species of the genus as now accepted; *Gobio*

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*Jacobi Theodori Klein Historiæ Piscium promovendæ Missus quintus et ultimus de piscibus per branchias apertas respirantibus, *Gedani*, Litteris Schreiberianis, 1749.

is equivalent to *Gobius* of Linnæus; *Asperulus* to *Aspro* of Cuvier; and *Trichidion* to *Polynemus* of Linnæus.

The group, it will be thus seen, is composed of very dissimilar elements. From it are also excluded *Perca*, and other genera with the dorsal fins quite as distinct. The Perches are placed in a group of which the character is the presence of only one dorsal entire or sinuate.

Labrax itself is defined* as having as many fins as *Cestræus* (or *Mugil* Linn.); serrated scales; the mouth large, and provided with numerous slender teeth in many rows. Two species are referred to it: the *Labrax diacanthus* Gill (*Sciæna diacantha* Bloch, *Labrax lupus* Linn.); and the *Centropomus undecimalis* of Lacépède, and the moderns. The genus itself is therefore not very unnatural, but its characters are common to many others, especially to *Perca.*

In the second and third volumes of the great "Histoire Naturelle des Poissons", Cuvier and Valenciennes have referred to the genus *Labrax* seven nominal species, six of which are described in the former volume.

Of these, the *Labrax lupus* is the type of the genus, and is distinguished by the spur-like spines of the inferior margin of the preoperculum; the presence of a perfect marginal band of teeth, and of an oval basal patch on the tongue; three spines to the anal fin; and other characters, which have been noticed in the preceding synopsis. To this should the name *Labrax* be restricted.

The second species (*le Bar alongé*, or *Perca elongata* of Geoffroy) is distinguished by finer and more numerous teeth on the inferior border of the preoperculum, and the presence of only two anal spines. The distinctive characters of this species, however, require to be confirmed.

The third species is the *Labrax lineatus* of Cuvier, the common Rock-fish or Striped Bass of the United States. This has been taken as the type of a new genus, for which Mitchill's name *Roccus* is preserved. The characters are given below. To this genus should be also referred the *Labrax multilineatus* described by Cuvier and Valenciennes in the third volume of their "Histoire Naturelle des Poissons".

The fourth species, *Labrax Waigiensis*, has been identified by Bleeker with the *Psammoperca datnioides* of Richardson; if this is correct (and, notwithstanding the discrepancies between the descriptions of the "Histoire Naturelle" and Richardson, such appears to be the case), it belongs to a very distinct genus from the *Labrax lupus.* The teeth of the jaws, vomer, and palatines are described by Richardson as crowded, rounded, and granular, while by Cuvier the teeth on both jaws, the chevron of the vomer, and the palatines are said to be villiform ("dents en velours"): it is also stated by Cuvier that there is a small oval disk at the base of the tongue; by Richardson, the tongue is said to be smooth. In the latter statement, however, he disagrees not only with Cuvier and Valenciennes, but with Bleeker, who also asserts† that there is an oblong patch at the base of the tongue, "lingua basi thurma denticulorum scabra." Both authors agree as to the presence of a single spine to the operculum (although one of the generic characters assigned to *Labrax* by Cuvier was the presence of two spines on that bone), and of a strong horizontal spine at the angle of the preoperculum, above which the margin is pectinated.

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*Pinnas habet tot quot Cestræus et Mugil: squamas serratas: os magnum plurimis tenuissimisque dentibus multiplici ordine munitum. Voracissimus.

† Natuurkundig Tydschrift voor Nederlandsch Indie, vol. ii, p. 479.

The next species in order, *Labrax Japonicus* of Cuvier and Valenciennes, is the type of the genus *Lateolabrax* of Bleeker,* which is widely separated from *Labrax* by the absence of any teeth on the tongue, the increased number of its vertebræ, &c. In the plectroid armature of the operculum, it however resembles that genus.

The last species, *Labrax mucronatus*, is also now considered as the type of a new genus, for which the name *Morone* is accepted. Its generic characters and affinities will be given at length in a subsequent portion of this memoir.

Of the seven species referred by Cuvier and Valenciennes to the genus *Labrax*, five are thus seen to belong to different genera. Nor do any of these genera appear to be unnecessary; but, on the contrary, all of them are well distinguished from each other by characters that ichthyologists must admit are of importance: two of the species, indeed, that were referred to the genus by the French naturalists, do not agree with their diagnosis of that genus, and it is doubtful, indeed, whether they have any near relations with the others. It is not in disparagement of those celebrated and able men that these remarks have been made. The progress of scientific discovery and the examination of better materials have enabled their successors to discover the errors of the founders of modern ichthyology. None could have performed the work at that day better than they.

Having long since, from an examination of the descriptions of various authors, been aware of the confusion and uncertainty in which our American species of the Cuvierian *Labrax* were enveloped, I believed that it might be a useful task to attempt the elucidation of the genus. The results of the investigations undertaken therefor have been published, in the Proceedings of the Academy of Natural Sciences of Philadelphia for April, 1860, as a "Monograph of the Genus *Labrax* of Cuvier."

Most of our general remarks are reproduced, with many additional ones, in the present report. The nominal American species admitted by Drs. De Kay and Storer in the genus *Labrax* amount to seven, and another specific name has been since added by Filippi, an Italian naturalist. It has been attempted to demonstrate, in our monograph of the genus, that all of those nominal species are referable to three true ones. Three of the synonyms apply to one species, and four to another.

Besides the species that have been attributed to the genus by Richardson, De Kay, and Filippi, several others have been described under that name by modern naturalists. Dr. Charles Girard has noticed two of these in the "Proceedings of the Academy of Natural Sciences of Philadelphia" under the names *Labrax nebulosus* and *L. clathratus*. He afterward constructed for them a new genus, which he called *Paralabrax*, and correctly placed it in the vicinity of *Serranus;* they are indeed very closely related to that genus as now restricted.

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* By a misunderstanding, the name *Percalabrax* has been taken by some authors as the generic denomination of this type. Cuvier (Hist. Nat. des Poissons, i, 55) has remarked, "Nous avons cru, pour plus de clarté, devoir donner un nom particulier à chaque sous-genre; mais ceux qui tiendraient à conserver la nomenclature des grands genres de Linnæus, pourraient placer ce nom sous-générique entre deux parenthèses, comme Linnæus l'a fait en quelques occasions, et dire, par exemple; *Perca (labrax) lupus; Perca (labrax) lineata*, etc." Temminck and Schlegel, following this suggestion but omitting the parentheses, called the *Perca (labrax) Japonicus, Perca-Labrax Japonicus*, evidently accepting the views of Cuvier as to the limits of the subgenus *Labrax*. Bleeker, quite properly recognizing the generic peculiarities of the species, called it *Lateolabrax;* but Dr. Albert Günther (in the first volume of a Catalogue of the Acanthopterygian Fishes in the Collection of the British Museum, 1859, p. 70), mistaking the meaning of Temminck and Schlegel, has called it *Percalabrax*.

Mr. Hill, of Jamaica, in a useful catalogue of the fishes of that island, has also noticed a fish which he referred to *Labrax* under the name of *L. pluvialis*, or the Rainy-weather Chub. It is said by that gentleman to be confounded by the fishermen with the *Labrax mucronatus* (=*Morone americana* of this article), but differs from it by the presence of vertical bars, like those of the common perch of Europe and America. Until more authentic information is obtained, the relations of that species must be entirely conjectural, and it is probable that it has no affinity to the *Labraces.*

GENUS ROCCUS, (MITCH.) GILL.

Synonymy.

ROCCUS *Mitchill*, Report in part on the Fishes of New York, p. 25, 1814.
ROCCUS *Gill*, Proceedings Academy of Natural Sciences of Phila., vol. xi, p. 111, 1860.
LEPIBEMA *Raf.*, Ichthyologia Ohiensis, p. 23, 1820.
SCIÆNA sp. *Bloch.*
PERCA sp. *Bloch and Schneid., Mitchill*, 1818.
CENTROPOME sp. *Lac.*
LABRAX sp. *Cuv., auct. al.*

Labraces with pectinated preoperculum, cycloid or imperfectly ctenoid cheek and opercular scales, lingual teeth developed in a marginal band as well as at the base, and skull with compressed non-diaphanous brain-case and no mastoid projections.

The body is elongate, subfusiform or oblong-ovate, compressed, and with the back anteriorly curved.

The head is compressed, laterally oblong conic. The operculum is armed with two spines, the upper of which is small; the preoperculum pectinated both behind and below; the suborbital bones entire. The muciferous cavities of the lower jaw are not very evident.

Teeth on the intermaxillary, dentary, palatine, and vomerine bones villiform; those on the tongue present in a band along the lateral margins, and in two longitudinal rows, or an elongated oval patch at the base. Interbranchial osselets smooth.

The scales are ctenoid on the body, but on the head, from the nape to the nostrils, and on the cheeks, are mostly cycloid.

The lateral line is straight and continuous to the base of the caudal fin.

The dorsal fins are not united by a perceptible membrane; the anterior fin has nine spinous rays; the second is oblong, with one spinous, and from eleven to fourteen branched ones.

The anal fin is opposite the second dorsal, and has three spinous rays regularly increasing in size.

The caudal is emarginate.

The skull has the brain-case with nearly flat sides below, rectilinear and flat toward the aperture for the last two branches of the fifth nerve, a vacuity on each side between the basioccipital and alispheroid bones, and the postfrontals laterally well developed.

The genus *Roccus* is very closely allied to both *Labrax* as now restricted as well as to *Morone.* From *Labrax*, it differs chiefly in the character of the armature of the preoperculum, and by the absence of the teeth at the anterior extremity of the tongue; the whole margin of the tongue in the latter genus being provided with a band of villiform teeth, and the spur-formed teeth of the inferior margin of the preoperculum calling to mind the genus *Plectropoma* of Cuvier among the *Serrani*. The difference between the last-named genus, or at least some of its species, and *Serranus* is indeed not of as great value as that between *Labrax* and *Roccus*. The only constant character between *Serranus* and *Plectropoma*, as those genera were established by Cuvier, is the spur-like armature of the inferior border of the preoperculum, while *Labrax* and *Roccus* are distinguished, not only by an equally great and constant difference of the preopercular border, but also by the difference of the lingual dentition. As the former character is of as great value in the *Labraces* as in the *Serrani*, consistency will require that if *Plectropoma* and *Serranus* are considered as distinct genera, *Roccus* and *Labrax* should also be so regarded.

The difference between *Roccus* and *Morone* is of even more importance than that of *Roccus* and *Labrax*. The distinguishing characters will be referred to under the diagnosis of *Morone*.

The name which has been adopted for this genus is one given by Dr. Mitchill, in the year 1814, to a medley comprising the *Roccus lineatus* (which he called *Roccus striatus*) and the *Otolithus regalis* (which was designated as *Roccus comes*). The name was solely the result of ignorance, on the part of the author, of the application of the ordinary terms used by naturalists at that day.

As the work in which the name of *Roccus* was first published is very rare and inaccessible, the remarks of Mitchill on his *Roccus striatus* have been extracted to show the character of the work. We are indebted to Mr. Brevoort for the loan of the volume.*

"It has seemed to me proper to make a new genus for this fish and his congeners. He has been supposed by some to be the *Perca nobilis*,† but the position of his ventral fins forbids him to be considered as a *Perca* at all. Besides, if he was a member of the *Perca* family, the specific character of 'eight brown bands' is totally different from the longitudinal stripes that distinguish him, and would rank him among the undescribed species. Besides, he has two dorsal fins, while the *P. nobilis* has but one."

In the first place, the so-called *Roccus striatus* does not differ from the very common European Perch, and from the numerous allied species and genera, in the position of the ventrals.

In the next instance, even if it did so differ, Mitchill had, on a previous page, founded a genus for the same reason as in the case of *Roccus*, and he has given no indications whatever as to how the two are to be generically distinguished.

The two species that are referred to *Roccus* belong to totally distinct families.

Finally, the "*Roccus striatus*" had been indicated previously in four different works.

The name *Roccus* is itself a barbarous latinization of the popular name "Rock-fish", or simply "Rock", by which its chief species is known in some parts of the United

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* Report, in part, of Samuel L. Mitchill, M. D., Prof. of Natural History, &c., on the Fishes of New York. New York: printed by D. Carlisle, No. 301 Broadway, January 1, 1814. 16mo, 28 pages.

† It is not in any way related to the *Perca nobilis*. According to Cuvier and Valenciennes, that species is the *Chætodon octofasciatus* of Bloch.

States, especially in the District of Columbia, Maryland, and Philadelphia. It has been nevertheless deemed advisable to accept the name rather than to apply a new one. It is scarcely worse than *Lumpus*, *Gunnellus*, *Vogmarus*, *Kangarus*, *Catus*, *Rattus*, and many other names of similar derivation, which have been introduced into systematic nomenclature.

C. S. Rafinesque, in the "Ichthyologia Ohiensis", also proposed for his *Perca chrysops*, in case it should be found to be generically distinct from *Perca*, the name *Lepibema*. He believed it to be distinguished "by the scaly bases of the caudal, anal, and second dorsal fins, the last with some spiny rays, and all the three parts of the gill-cover more or less serrulate, besides the small teeth". Rafinesque suggested that to this genus the *Perca Mitchilli* of Mitchill might "perhaps be found to belong".

The distinctive characters mentioned by Rafinesque alone are very trivial; but *Roccus* is certainly distinguished by the presence of scales between the rays of the second dorsal and anal fins from *Perca*, in which the membrane is perfectly naked. But the opercula are not more completely armed than in *Perca*, nor is there any essential difference in the size of the teeth.

ROCCUS LINEATUS, GILL.

Synonymy.

SCIÆNA LINEATA *Bloch*, Ichthyologie, pars ix, p. 53, pl. 305.
PERCA . . . . . *Schœpff*, Schrift. der Gesells. Nat.-Freunde, vol. viii, p. 160.
PERCA SAXATILIS *Walbaum*, Artedi Genera Piscium, p. 330.
PERCA SAXATILIS *Bloch*, Systema Ichthyologiæ Schneid. ed., p. 89.
PERCA SEPTENTRIONALIS *Bloch*, Systema Ichthyologia Schneid. ed., p. 90, pl. 70.
CENTROPOME RAYÉ *Lac.*, Hist. Nat. des Poissons, vol. iv, p. 225.
ROCCUS STRIATUS *Mitchill*, Report, in part, on the Fishes of New York, p. 25, 1814.
PERCA MITCHILLI *Mitchill*, Trans. Lit. and Phil. Soc. N. Y., vol. i, p. 413, pl. 3, fig. 4.
ROCK FISH *Mease*, Trans. Lit. and Phil. Soc. N. Y., vol. i, p. 502.
PERCA MITCHILLI
LEPIBEMA MITCHILLI } *Raf.*, Ichthyologia Ohiensis, p. 23 (passim).
LABRAX LINEATUS *Cuvier* and *Val.*, Hist. Nat. des Poissons, vol. ii, p. 79.
PERCA LABRAX ! *Smith*, Nat. Hist. Fishes of Mass., p. 277.
LABRAX LINEATUS *Rich*, Fauna Boreali-Americana, vol. iii, p. 10.
LABRAX LINEATUS *Storer*, Report on the Fishes of Mass., p. 7.
LABRAX LINEATUS *Ayres*, Boston Journ. Nat. Hist., vol. iv, p. 707.
LABRAX LINEATUS *De Kay*, Zoölogy of N. Y. Fishes, p. 7, pl. 1, fig. 3.
LABRAX LINEATUS *Linsley*, Catalogue of Fishes of Connecticut.
LABRAX LINEATUS *Storer*, Synopsis Fishes of N. America, p. 21; ib. in Memoirs Am. Acad.
LABRAX LINEATUS *Storer*, Hist. Fishes of Mass.; ib. in Memoirs Am. Acad. vol. v, p. 55, pl. 1, fig. 4, 1853.
LABRAX LINEATUS, *Baird*, Report on Fishes of New Jersey Coast, p. —; ib. in Ninth Annual Report of Smith. Inst., p. 321.
LABRAX LINEATUS *Holbrook*, Ichthyology of South Carolina, p. 17, pl. iv, fig. 2.
LABRAX LINEATUS *Gill*, Annual Report Smith. Inst., 1857, p. 255.
LABRAX LINEATUS *Günther*, Catalogue of the Acanthopterygian Fishes in the Collection of the British Museum, vol. i, p. 64.
ROCCUS LINEATUS *Gill*, Proceedings Acad. of Natural Sciences of Phila., 1860, p. 64.

ROCCUS CHRYSOPS, GILL.

Synonymy.

PERCA CHRYSOPS
LEPIBEMA CHRYSOPS } *Raf.*, Ichthyologia Ohiensis, p. 28.
LABRAX MULTILINEATUS *Cuv.* and *Val.*, Hist. Nat. des Poissons, vol. iii, p. 588.
PERCA MULTILINEATA *Les.*, *fide Cuv.*, and *Val.*
LABRAX NOTATUS *Smith*, in Rich. Fauna Boreali-Americana, vol. iii, p. 8, 1836.
LABRAX MULTILINEATUS *Kirtland*, Boston Journal Nat. Hist., vol. v, p. 21, pl. 7 fig. 1; Visitor, p. 53, 1859.

LABRAX MULTILINEATUS *De Kay*, Nat. Hist. of New York Fishes, p. 14.
LABRAX ALBIDUS *De Kay*, Nat. Hist. of New York Fishes, p. 13, pl. 51, fig. 165.
LABRAX NOTATUS *De Kay*, loc. cit., p. 14.
LABRAX MULTILINEATUS *Storer*, Synopsis of the Fishes of North America, p. 22; ib. in Memoirs of American Acad., vol. ii.
LABRAX NOTATUS *Storer*, loc. cit., p. 22.
LABRAX ALBIDUS *Storer*, loc. cit., p. 23.
LABRAX OSCULATII *Filippi*, Revue et Magazin du Zoologie, 2d series, vol. v, p. 164.
LABRAX CHRYSOPS *Gill*, Proc. Acad. Nat. Sci. Phila., 1860, p. 20.
LABRAX OSCULATII *Günther*, Catalogue of the Acanthopterygian Fishes, &c., p. 65.
LABRAX MULTILINEATUS *Günther*, Catalogue of the Acanthopterygian Fishes, &c., p. 67.
ROCCUS CHRYSOPS *Gill*, Proceedings Acad. of Nat. Sciences of Phila., 1860, p. 113.
Not LABRAX CHRYSOPS *Girard*.
Not LABRAX MULTILINEATUS (partim) *Günther*, Catalogue of the Acanthopterygian Fishes, &c., p. 501.

The body is elongated-ovate, with the dorsal outline arched. The height is greatest under the spinous dorsal fin, and there equals twenty-seven hundredths of the entire length from the projecting lower jaw to the concave margin of the caudal fin. The height is nearly uniform under the spinous dorsal; the dorsal outline behind that fin slowly declines to the end of the second dorsal; the abdominal outline ascends much more rapidly from the commencement to the end of the anal fin. Behind the latter fin, the height of the caudal peduncle is about a seventh of the entire length; at the base of the caudal fin, it is equal to a ninth of the same.

The head is conical in profile, slightly depressed at the nape, and thence descends in nearly a straight line to the snout, the latter being scarcely convex. The head, from the lower jaw to the tip of the opercular spine, forms little more than a quarter of the entire length; its height at the nape behind the vertical of the posterior border of the eye is nearly equal to sixteen hundredths of the entire length. The diameter of the eye is more than equal to a quarter of the head's length, and the eye is distant a diameter from the snout.

The pectinated margin of the preoperculum is slightly oblique; its teeth become stronger toward the angle, and are continued on the inferior margin at greater distances for about half the distance between the angle and the articulation with the lower jaw; the anterior limb or margin of the anterior fold is vertical. The operculum has two spines, separated by an oblique emargination.

The first dorsal fin commences over the bases of the ventrals, and is of a triangular form. The fourth spine is longest, and equals an eighth of the fish's length; from thence they gradually decrease in size to the ninth, which is nearly as large as the second. The second dorsal is entirely separated from the first. Its spine is equal to nearly half the length of its longest ray, and somewhat exceeds that of the seventh spine; the last ray is less than half as long as the longest.

The anal fin commences nearly under the fourth ray of the dorsal, and nearly four of its rays are posterior to the end of that fin; the third spine is longest, and exceeds half the length of the first articulated or longest ray. The relative height is the same as that of the dorsal fin.

The caudal fin, when expanded, is emarginated, and its shortest rays form a sixth of the entire length; the longest rays equal a quarter of the same.

The pectoral fins are small, and only equal fifteen hundredths of the length. The first two rays are simple; the third, or longest, is branched.

The ventrals are longer than the pectorals, and equal seventeen hundredths of the length. The spine is more than half as long as the first branched or longest ray.

The number and arrangement of the rays of the respective fins are indicated by the following formula:

D. IX + I. 1. 11; A. III. 1. 9; C. 5. I. 8. 7. I. 4; P. 2. 14; V. 1. 5.

The scales of the trunk are of moderate size, with the nucleus at about the posterior third; thence about ten ridges radiate toward the posterior margin, which is crenated by them. Numerous muricated ridges, terminating in pectinations at the posterior margin, also radiate posteriorly from the same nucleus. The concentric striæ are fine but well marked. The number of scales through which the lateral line passes amounts to from fifty-three to fifty-six, exclusive of the smaller ones at the base of the caudal fin. The number of rows is nine above the lateral line, one through which the lateral line runs, and fourteen below.

The operculum is covered with moderate scales, which have subcentral nuclei and muricated and pectinated posterior margins. Those on the cheeks are much smaller, with the nuclei also subcentral, but with generally entire, or nearly entire, margins. Some of the larger scales near the posterior margin of the preoperculum are pectinated like the opercular ones.

There are on the lower jaw five pairs of indistinct, shallow, muciferous grooves; those of the third and fourth pairs are elongated, the last being under the terminal part of the maxillaries. The fifth pair is obsolete. The maxillaries, on their superior parts, are covered with scales smaller than those of the cheeks; the inferior and posterior portions are naked.

The color is silvery, tinged with golden on the sides below the lateral line, and above with rose. A number of blackish or dusky lines traverse the sides, four of which are above the lateral line; through a fifth the lateral line runs; and there is a variable number of more or less distinct ones below. The head is dark above and silvery on the sides.

The spinous dorsal is punctulated with black, and has a narrow black margin. The soft dorsal is also punctulated. The anal is blackish at its middle and margin between the rays. The caudal is similar to the dorsal. The pectorals and ventrals are immaculate.

The *Roccus chrysops* thus described is undoubtedly identical with the *Perca* or *Lepibema chrysops* of Rafinesque, and the *Labrax multilineatus* of the "Histoire Naturelle des Poissons" and of Kirtland. The descriptions that have been given of the species under those names are meager and unsatisfactory; but the notice of the color given by the above-named authors, and the possession of specimens from the same hydrographical basins as those from which the fishes described by them were taken, leave no doubt as to the identity of the species.

Rafinesque's description of his *Perca chrysops* is, like almost all his descriptions, inapplicable to any known fish, but it agrees with the *Morone chrysops* better than any other species. Rafinesque erroneously attributes to his species six branchiostegal rays, a single opercular spine, eight spines to the first dorsal fin, and places it under the genus *Perca*, all the species of which, he informs us, have naked heads. He suggested for it a new genus, for which he proposed to give the name *Lepibema*, in allusion to the scaly bases of the unpaired fins. Lesueur subsequently sent to the Parisian Museum two specimens of a species which he called *Perca multilineata*, which Cuvier and Valenciennes placed in their genus *Labrax*, adopting for it the specific name of Lesueur. Their description is mostly comparative, it being said to differ from the *Labrax lineatus* by its higher body, shorter head, more feeble teeth, the stronger asperities of the tongue, and especially the larger scales of the maxillaries, which resemble those of *Labrax mucronatus*, while in *Labrax lineatus* they were said to be scarcely perceptible.

The description of the lingual dentition is very unsatisfactory, and no correction is made of the statement made in the second volume that the *Labrax lineatus* has only lateral teeth. It is not so much in the development of the asperities of the tongue that the lingual dentition of the species differs, as in that, while there are two narrow rows separated by a mesial line in *Roccus lineatus*, the rows are broader at the middle in proportion, and coalescent in *Roccus chrysops*.

There were said to be in one specimen sixteen, and in another nineteen, longitudinal dark lines. So large a number is rarely seen; the most constant arrangement is five above, including the one through which the lateral line runs, while sometimes there are several below the lateral line, and at other times they are obsolete. These lines are sometimes straight, but often interrupted.

In the "Fauna Boreali-Americana" of Richardson, a *Labrax* is described in the volume on Ichthyology, under the name *Labrax notatus* (Smith), the Bar-fish, or "Canadian Basse". This species is said to "differ from Mitchill's Basse (*L. lineatus*, Cuvier) in being much more robust, and in being marked with rows of spots, five above and five below the lateral line, so regularly interrupted and transposed as to appear like ancient church-music". It has been suggested by Dr. De Kay that it is the same as the *Perca Mitchilli* var. *interruptus* of Mitchill, but the comparison will apply very well to *Roccus chrysops*, and it is doubtless identical with that species. In the remarks upon the species, it is said, by Dr. Richardson apparently, that "in the more robust form, and in the strong scales of the head, the Canadian Bar-fish resembles the *L. mucronatus* of the United States and the West Indies, and the *L. multilineatus* of the Wabash. The latter has sixteen narrow, black, longitudinal lines on the flanks." It has been attempted to show that the number of lines is not a specific character; and if this is the case, the *Labrax notatus* and *L. multilineatus* are probably identical with each other and with *Roccus chrysops*. The *Labrax notatus*, it is true, is stated by Smith to have but one anal spine and six articulated ventral rays; but this statement is undoubtedly due to a *lapsus calami*, or an error of observation. So great a variation in the number of anal spines, from a nearly allied species, would be in direct opposition to all we know of the peculiarities of the fishes of this tribe, while it is one of the characters of the family to have only five branched rays in the ventral fins. Smith states that he counted fifty-eight scales along the lateral line, a statement which confirms the identity of his species with *Roccus chrysops*.

In the abstracts of Smith's description of *Labrax notatus*, given by De Kay and Storer, the species is said to have the "length, one to two feet". Even if this was so, it would not militate against the idea of its identity with *Roccus chrysops*, although usually large, but an examination of the description of Smith and Richardson reveals no mention whatever of the size of the species.

In the number of Guerin's "Revue et Magazin de Zoologie" for April, 1853 (vol. v, p. 164), Professor Filippi, of Turin, has described a *Roccus*, to which he has given the name of *Labrax Osculatii;* a traveler in America, M. Osculati, having obtained it from Lake Ontario. Filippi has distinguished this species from *Labrax lineatus* very well, alluding to the two longitudinal lines of basal teeth in that species, and attributing to his own a single oval patch. His other characters are the greater height of the body in *L. Osculatii*, which equals a third of the length, while in *L. lineatus* it is a quarter, and the number of scales, which are formulated as $56\frac{9}{15}$ for *L. Osculatii* and $64\frac{9}{11}$ for *L. lineatus.* The true teeth are also said to be more numerous. The distinctive characters of the species are very well stated by Filippi, but his expression of surprise that a fish so common in the United States should not have been noticed by any American naturalist, not even by Dr. De Kay, is uncalled for. Unhappily, the species had been too often noticed, and in De Kay's Ichthyology of New York it appears under no less than three different names. Filippi has mentioned its habitat as the sea and rivers of the United States (*mare et fluviis Confederationis Americanæ*). I know not on what authority it is said to inhabit the sea. It is probably assumed to be found there because the *Roccus lineatus* is. So far as we know, it is confined to the great fresh-water lakes and the western rivers.

As Filippi has already led one naturalist into error regarding the proportions of the species, it seems necessary to state that he must have reckoned the length only from the snout to the base of the caudal fin, and not to its margin. When so measured, the height is a third of the length, but its height in proportion to the total length is only as three to ten.

Specimens of the *Roccus chrysops* are in the museum of the Smithsonian Institution, from Southern Illinois, obtained by Mr. Robert Kennicott, and from the Root River, at Racine, Wis., Toronto, &c., obtained by Professor Baird. It appears to be generally distributed in the rivers of the West.

The specimens from the hydrographical basins of the Ohio River and of the Great Lakes cannot be specifically distinguished from each other; nor can I perceive the difference signalized by Dr. Kirtland in the caudal fins of Ohio and Lake Erie specimens.

In extreme youth, this species appears to be crossed by obscure vertical bands. At a later epoch, these bands are lost, and afterward the longitudinal lines are assumed.

The best descriptions of this species have been published by Professor Filippi under the name *L. Osculatii*, and by the late Dr. De Kay under that of *L. albidus.* The best figure is that given by Dr. Kirtland in the Journal of the Boston Society of Natural History; but the dorsals are erroneously represented as being connected by a low membrane. In the text, they are correctly described as being "distinct".

It is with much hesitation that I have adopted the specific name of Rafinesque. It would have been better for the progress of the science if all the works of that unfortunate naturalist had been ignored.

GENUS MORONE, GILL.

Synonymy.

MORONE *Mitchill*, Report in part on the Fishes of New York, p. 18. (Not defined.)
MORONE *Gill*, Proceedings Academy of Nat. Sciences of Phila., 1860, p. 115.
PERCA sp. *Bloch*, Gmelin, Lac.
CENTROPOMUS sp. *Rafinesque.*
BODIANUS sp. *Mitchill.*

Labraces with a pectinated preoperculum, strongly ctenoid cheek and opercular scales, lingual teeth developed only in a marginal band, and skull with swollen diaphanous brain-case and mastoid protuberances projecting toward the foramina for the last two branches on each side of the fifth nerve.

The body is oblong-ovate and slightly gibbous at the commencement of the dorsal fin.

The head is compressed, laterally oblong-conic. The operculum has two spines, the upper of which is smaller; the preoperculum pectinated behind and beneath; the suborbital bones entire. The muciferous cavities of the lower jaw are very perceptible.

The teeth on the intermaxillary, dentary, vomerine, and palatine bones are villiform. There is only a marginal band on the tongue, which is less perfect at the tip, the asperities being there more scattered. The interbranchial osselets are smooth.

The scales are ctenoid on the body and the entire head.

The lateral line anteriorly convex, but not parallel with the back.

The dorsal fins are united by a low membrane; the anterior has nine spines; the posterior, one. The anal fin has three spines. The caudal is emarginated.

The skull has the brain-case with inflated sides below, swollen and developing into mastoid prominences projecting toward the foramina for the last two branches of the fifth pair of nerves, no vacuity between the basioccipital and alisphenoid bones, and the postfrontals laterally contracted.

The chief distinctive characters of the genus are the presence of strongly-pectinated scales on the cheeks and opercular bones, and the band of villiform teeth on the sides, and of more scattered ones at the tip, as well as the cranial peculiarities.

In the armature of the preoperculum and operculum, it resembles the genus *Roccus.* The slightly gibbous back in front of the dorsal fin and the greater development of the second anal spine are secondary features, which support the natural characters of *Morone* as distinguished from the genus *Roccus.*

For the name of the genus, one used by Mitchill for a group founded in error has been adopted. The name of Mitchill resulted from a misunderstanding of that author regarding the value of the terms made use of by Linnæus. The genus *Perca* was placed by the Swedish naturalist in his section of *Thoracici.* Mitchill, believing that the *Morone americana*, *Perca americana* (*Perca flavescens* Cv.), and *Pomotis aureus* (*Pomatis vulgaris* Cv.), were rather abdominal fishes, considered them to be generically distinct from *Perca*, and consequently gave to them the generic name *Morone.* It is scarcely necessary to state that all the species enumerated have the normal position of the ventrals of *Perca*, and that therefore *Morone* of Mitchill was a mere synonym of

Perca of Linnæus. I have nevertheless chosen to take that name rather than to give a new one.

At least two species are now known of the genus *Morone*. One of them is the well-known "White Perch" of the eastern coast; the other is our *Morone interrupta*, a species that had been erroneously described under the name *Labrax chrysops*.

The synonymy of each species will be given, but a description is only offered of the *Morone interrupta*.

MORONE AMERICANA, GILL.

Synonymy.

PERCA *Schoepff*, Schrift. der Gesells. Nat.-Freunde, vol. viii, p. 159.
PERCA AMERICANA *Gmel.*, Systema Naturæ, vol. i, pars iii, p. 1308.
PERCA *Schoepff*, Naturforscher, vol. xx, p. 17.
PERCA IMMACULATA *Walbaum*, Artedi Genera Piscium, p. 330.
PERCA AMERICANA *Bloch*, Systema Ichthyologiæ, Schneid. ed.
PERCA AMERICANA *Lac.*, Hist. Nat. des Poissons, vol. iv, p. 412.
MORONE RUFA *Mitchill*, Report, in part, on the Fishes of New York, p. 18.
BODIANUS RUFUS *Mitchill*, Trans. Lit. and Phil. Soc. of New York, vol. i, p. 420, Jan., 1814.
BODIANUS RUFUS, Centropomus albus Raf.; Précise des découvertes Somiologiques, p. 19, June, 1814.
PERCA MUCRONATA *Raf.*, American Monthly Magazine and Critical Review, vol. ii, p. 205.
LABRAX MUCRONATUS *Cuv.* and *Val.*, Hist. Nat. des Poissons, vol. ii, p. 81, pl. 121.
BODIANUS RUFUS *Smith*, Nat. Hist. Fishes of Mass., p. 274.
LABRAX MUCRONATUS *Storer*, Report on Ichthyology of Mass., p. 8.
PERCA MUCRONATUS (misprint) *Sw.*, Nat. Hist. of Fishes, Amphibious and Reptile, vol. ii, p. 198, 1839.
LABRAX RUFUS *De Kay*, Nat. Hist. of New York Fishes, p. 9, pl. 3, fig. 7.
LABRAX MUCRONATUS *Ayres*, Boston Journal Nat. Hist., vol. iv, p. 257.
LABRAX MUCRONATUS *Linsley*, Catalogue of Fishes of Connecticut.
LABRAX RUFUS *Storer*, Synopsis of the Fishes of North America, p. 22; ib. in Memoirs of American Academy, new series, vol. ii, p. 274, 1846.
LABRAX RUFUS *Storer*, Hist. of the Fishes of Mass., p. 1; ib. in Memoirs of American Acad., new series, vol. v, p. 57.
LABRAX MUCRONATUS *Baird*, Report on Fishes of New Jersey Coast, p. 8; ib. in Ninth Annual Report of Smith. Inst., p. 322, 1855.
LABRAX AMERICANUS *Holbrook*, Ichthyology of South Carolina, p. 21, pl. 3, fig. 2, 1855.
LABRAX RUFUS *Gill*, Annual Report of Smith. Inst., p. 256, 1857.
LABRAX MUCRONATUS *Hill*, Catalogue of Fish of Jamaica, p. 1.
LABRAX RUFUS *Günther*, Catalogue of the Acanthopterygian Fishes of the British Museum, p. 65.
LABRAX NIGRICANS *De Kay*, Nat. Hist. of New York Fishes, p. 12, pl. 50, fig. 160, 1842.
LABRAX NIGRICANS *Storer*, Synopsis of the Fishes of North America; ib. in Memoirs of American Acad., vol. ii, p. 23, 1846.
GRYSTES NIGRICANS *var.* 1 *Herbert*, Frank Forrester's Fish and Fishing in the United States, vol. i, p. 191.
MORONE PALLIDA *Mitchill*, Report, in part, on the Fishes of New York, p. 18.
BODIANUS PALLIDUS *Mitchill*, Trans. Lit. and Phil. Soc. of New York, vol. i, p. 420.
BODIANUS PALLIDUS *Smith*, Nat. Hist. of Fishes of Mass., p. 294.
LABRAX PALLIDUS *De Kay*, Nat. Hist. of New York Fishes, p. 11, pl. 1, fig. 2, 1842.
LABRAX PALLIDUS *Storer*, Synopsis of the Fishes of North America, p. 22; ib. in Memoirs of American Acad., vol. ii, p. 22.
LABRAX PALLIDUS *Perley*, Report upon the Fishes of the Bay of Fundy, p. 121, 1851.
LABRAX PALLIDUS *Perley*, Descriptive Catalogue (in part) of Fishes of New Brunswick and Nova Scotia, p. 4; ib. in Reports on Sea and River Fisheries of New Brunswick, p. 182, 1852.
LABRAX PALLIDUS *Günther*, Catalogue of the Acanthopterygian Fishes of the British Museum, p. 67.

The history of this species and its nomenclature has been fully discussed in the monograph published in the Proceedings of the Academy of Natural Sciences. It is therefore unnecessary to reproduce it in this report, the species not being an inhabitant of those regions traveled over by the expedition under Captain Simpson.

Günther has recently, in his "Catalogue of the Acanthopterygian Fishes in the Collection of the British Museum", retained the *Labrax pallidus* and *Labrax rufus* as distinct species. We see no reason to change our opinion concerning their identity expressed in our monograph.

MORONE INTERRUPTA, Gill.

Synonymy.

LABRAX CHRYSOPS *Girard*, General Report upon the Zoölogy of the several Pacific Railroad routes, Ichthyology, p. 29 (pl. xi, figs. 1-4).
LABRAX CHRYSOPS *Girard* (figured in Governor Stephen's Report).
MORONE INTERRUPTA *Gill*, Proceedings Acad. of Nat. Sciences of Phila., 1860, p. 118.

The body is oblong ovate, with the back at the commencement of the dorsal fin slightly gibbous. The greatest height under the spinous dorsal equals three-tenths of the length from the snout to the concave margin of the caudal fin. The dorsal outline slightly declines under the spinous dorsal and little more under the rayed. The abdominal outline to the anal fin is convex, and thence ascends quite rapidly in a concave curve to the base of the caudal fin. The peduncle behind the anal fin exceeds a seventh of the extreme length, and at the base is equal to about a ninth.

The head is conical in profile, slightly depressed at the nape, and thence nearly straight to the snout. The head from the snout to the opercular spine forms three-tenths of the length, its length being scarcely less than the height of the body. The eyes are moderate, the diameter being between a fourth and a fifth of the head's length. They are distant much more than a diameter from the snout.

The anterior margin of the preoperculum advances obliquely downward and forward; the pectinate margin is nearly vertical; the distance between the margins near the angle exceeds half the diameter of the eye. The teeth of the posterior margin become stronger toward the angle; the inferior margin is weakly serrated along its posterior half. The operculum has two spines, separated by an oblique sinus; the superior one is blunt and almost rounded.

The dorsal fin commences at a vertical intermediate between the bases of the pectoral and ventral fins and is of a triangular form, the fourth ray being the largest and equaling the length of the pectoral fin; the spines have the same form and arrangement as those of *Morone americana*. The second dorsal is connected by a membrane as in *Morone americana;* its spinous or first ray is little more than half the length of the first articulated one, which itself is nearly as long as the fourth dorsal spine; the fin thence decreases in height toward its last ray, which is shorter than the spinous ray.

The anal fin commences under the fourth or fifth articulated ray of the second dorsal, and about four of its rays are posterior to the termination of that fin; the first spine is short and robust; the second almost two and a half times longer, compressed, and very strong; the third is almost as long as the second, but much more slender. The first articulated ray of the anal is longer than the spines, and about twice as long as the last; the outline of the fin is slightly emarginated.

The first ray of the pectoral fin is, as usual, articulated, but simple; the third is longest and branched, and equals the base of the second dorsal.

The ventrals are about as long as the pectorals; the length of the spine is equal to two-thirds of that of the first or second branched rays.

The radial formula is as follows:

D. IX. I. 12; A. III. 10; C. 4. I. 8. 7. I. 3; P. 2. 14; V. 1. 5.

The scales are of about the same size as in the *Morone americana*, the lateral line running through about fifty besides the smaller ones at the base of the caudal fin; at the region of its greatest height, there are about nineteen rows, of which about one small and six large ones are above the lateral line and eleven beneath. The relative proportions on the different parts of the body are nearly the same as in that species, the chief difference existing on the front of the back, where the exposed portions of the disk are higher and narrower than in *M. americana.* On the cheeks from the orbit to the angles, there are seven oblique rows.

Those on the body are mostly higher than long, with the nucleus at about the posterior two-thirds, with numerous radiating, slightly terminally, muricated, ridges advancing posteriorly, and ending in teeth. About seven radiating ridges advance forward, some of them terminating at the anterior margin within the angles. These are crossed by numerous elevated concentric lines, parallel with the margins. The scales on the sides of the head and between the eyes are also pectinated like those of the body.

The lower jaw has five pairs of mucous pores as in *M. americana*, the fourth pair being largest and deepest, and under the terminal portion of the maxillaries; thence they regularly decrease in size to the anterior pair, which is on each side of the symphysis. The fifth pair is at the articulation of the jaw with the preoperculum, and is continued from the two inferior borders of that bone.

The specimens preserved in spirits have a bright, brazen color, tinged on the back with olivaceous. Along the sides are seven very distinct longitudinal black bands, through the fourth of which the lateral line runs for its entire length. The continuity of the bands below the lateral line is interrupted at the posterior half of their length, and they there alternate with their anterior parts.

The dorsal fins are tinged with purple, and the margin of the spinous one is dark. The anal is of a darker purple toward its anterior angle. The caudal, especially posteriorly and at its middle, is purple. The rays of the pectoral and ventral fins are yellowish, while the membrane of the former is hyaline, and of the latter sometimes minutely dotted.

This species, as will be observed by reference to the synonymy, has been described by Dr. Charles Girard, under the name of *Labrax chrysops* Girard (*Perca* or *Lepibema chrysops* Raf.), to which is also referred, as a synonym, the *Labxax multilineatus* of Cuvier and Valenciennes, Kirtland, De Kay, and Storer. From that species, it is very distinct, and even belongs to a different genus. Cuvier described the ground-color as a greenish-gray on the back and silvery on the belly. This is not the color of *Morone interrupta*, and that species must be therefore distinct from *Labrax multilineatus*, nor can it be the *Perca chrysops* of Rafinesque, which is said to be "silvery with five longitudinal brownish stripes on each side", and have the "head brown above". The description of the *Perca chrysops*, though erroneous in most respects, is as accurate as Rafinesque's generally are, and agree sufficiently well with Kirtland's *Labrax multilineatus*, which is doubtless identical with the Cuvierian species. Even such an observer as Rafinesque would have noticed the deep brazen hue of *Morone interrupta*, and would not have overlooked two of the seven very distinct black bands that run along the sides.

Dr. Girard has stated that there are but six branchiostegal rays in his species; but

I am able to say, from an examination of the specimens used by Dr. Girard himself for description, that it agrees with all allied species in having the normal number of seven, which are developed as in *Morone americana*.

There are preserved in the museum of the Smithsonian Institution three specimens of the *Morone interrupta*, one of which was obtained by Lieutenant Couch at New Orleans, and two larger ones were found at Saint Louis, Mo., by Dr. George Engelmann. The small specimen from New Orleans differs from the two Missouri specimens by the larger second spine of the anal fin, but in every other respect they are similar.

FAMILY COTTOIDÆ, (RICH.).

SUBFAMILY COTTINÆ, (BON.).

GENUS POTAMOCOTTUS, GILL.

Synonymy.

POTAMOCOTTUS *Gill*, Proc. Boston Soc. Nat. Hist.
COTTUS sp. *Agassiz*, Lake Superior, &c.
COTTUS sp. *Girard*, "Monograph of the Cottoids of North America" in Smithsonian Contributions to Knowledge, vol. iii.

Body elongated, anteriorly subcylindrical, and thence declining in height toward the caudal, where it is also much compressed. The skin is perfectly smooth and naked, except sides behind the pectorals.

Head conical or cuneiform in profile, oval above and depressed, and covered by a naked skin. The preoperculum is armed at its posterior margin with a strong spine, curved upward, and below with one or two smaller ones, or tubercles; the antero-inferior angle of the sub-operculum is also armed with a spine directed forward and downward. The other bones are unarmed.

Eyes mostly situated in the anterior half of the head; frontal bones between them of moderate width.

Mouth slightly oblique, and its gape is quite large.

Teeth villiform on the jaws and vomer as well as palatine bones.

Branchial apertures vertical and oblique, entirely separated from each other by a perfect isthmus, as wide or wider than the interval between the bases of the ventrals. There are six branchiostegal rays.

Dorsal fins two, either entirely separate or connected by a low membrane. The first has from six to nine slender spines.

Pectorals rounded, and their rays generally unbranched.

Ventrals nearly under the pectorals, and have a spinous and four (rarely three) unbranched rays.

The genus *Potamocottus* in every respect resembles the *Uranidea*, except in the presence of a band of villiform teeth on each palatine bone. Several species properly referable to this subgenus have been described as true *Cotti*. It is equally closely related to the genus *Cottopsis* of Girard, but is distinguished by its smooth skin. The species named by Girard *Cottopsis gulosus* is a true *Pottamocottus*.

The propriety of retaining the species with palatine teeth in the genus *Cottus* appears to be questionable. Dr. Girard, in his monograph of the genus, published by the Smithsonian Institution, has asserted that when young some species of *Cottus* "exhibit teeth-like asperities on the palatines. This occurs chiefly amongst those having four jointed rays to the ventrals: in *C. Wilsonii*, *C. Bairdii*, and *C. Meridionalis*. *C. gracilis* is the only one of the division with three jointed rays where similar asperities have been noticed." This assertion has not, however, been confirmed by my investigations. An examination of the types of the *Cottoids* described by Dr. Girard, in his "Monograph", has demonstrated that the presence or absence of teeth in the palatine bones is constant in the various species. In the *Cottus Richardsonii*, *C. Wilsonii*, and *C. meridionalis*, teeth are always found on the palatines, in the oldest as well as the youngest individuals. The *Cottus Bairdii* cannot be at present found; but the same is doubtless the case with that species. Many other specimens preserved in the Smithsonian Museum exhibit the same constancy in their dentition.

As to the *Cottus gracilis*, it is said by Dr. Ayres, in his Memoir on the Identity of the North American *Cotti* with the *Cottus gobio* of Europe, that of the very numerous specimens of the Connecticut *Cottus* (*C. gracilis* Heckel), which he had examined, he had seen a single one in which there were a few scattered teeth on the palatines, like those of the vomer; in others, those bones were edentulous. It is probable that that instance is alluded to by Dr. Girard in his mention of palatine teeth having been discovered in the *Cottus gracilis*. An isolated fact like that recorded by an observer who has failed to appreciate the distinctive characters of species of this group cannot, however, be urged as a valid objection to the importance of such characters. Nor could the circumstance that some *Cotti* have teeth when young, which they lose with age, militate against assigning a certain value to a plan of dentition which is constant through life, as well in the young and old. The difference of development alone would be a character of importance. But there does not appear to be even such difference between the dentition of the young and old. In those specimens which Dr. Girard described, the dentition is constant. Palatine teeth are even found in individuals which are much larger than any without. Such is the case with the species now under consideration; such is the case with other species equally large from the Western States.

If the above views are correct, it would then appear to be advisable to separate the *Cotti* with palatine teeth, and place them in another genus, or, at least, a subgenus, to which the name of *Potamocottus* may be given. This group will embrace the *Cottus punctulatus* as its type, and, in addition, *Cottus meridionalis* Girard, *C. Bairdii* Girard, *C. Wilsonii* Girard, and *C. Richardsonii* of Agassiz, as well as *Cottopsis gulosus* of Girard. The genus *Potamocottus* would bear the same relation to *Uranidea* that *Bryttus* does to *Pomotis*, or *Scorpæna* to *Scarpænopsis* of Hoeckel.

The genera *Uranidea*, *Potamocottus*, and *Cottopsis* agree very closely together, both in superficial and anatomical characters, and differ in the most decided manner from *Cottus* and the related genera; to express this divergence, the genera in question should be segregated in a group which may be named *Uranideæ*.

POTAMOCOTTUS PUNCTULATUS, Gill.

The general form of the body is similar to that of the first division of the first section of Girard's *Cotti.* It is elongated, slender, and considerably compressed. Of the extreme length, the head forms three-tenths parts and the caudal fin between a fifth and sixth. The trunk is anteriorly cylindrical, the height being scarcely more than the width behind the pectoral fins. The greatest height is at the commencement of the first dorsal fin, and exceeds a seventh of the extreme length; from thence, the height declines gradually to the caudal peduncle, where it is only equal to a third of the greatest. The breadth also declines uniformly, but more sensibly, to the base of the caudal, where it is very much compressed.

The head is much depressed, and rhomboidal-ovate above. From the snout to the membraneous margin of the operculum, it forms a third of the entirel ength. Its breadth is very great and is only about a sixth less than its length. The height at the occiput is about a half of the length. The snout is anteriorly broadly rounded.

The mouth is quite large; the jaws arched and receding; the distances between the extremities of the maxillaries being equal to the length of the caudal fin. The maxillary terminates under the anterior margin of the pupil. The upper jaw is somewhat protuberant beyond the lower.

The jaws are armed with bands of small, recurved, acute teeth; those on the dentaries are somewhat shorter than those of the premaxillaries, and reach much farther backward, extending to the angles of the mouth; the band is narrow as it recedes backward. At the symphysis of each jaw, there is a narrow interval, separating the bands into two equal parts. The chevron of the vomer and the palatines are also armed with bands of villiform teeth; those on the latter bones are perfectly evident, and almost as large as those of the vomer; they are in bands which are narrowed posteriorly.

The eyes are of the usual size, and situated about midway between the snout and the margin of the preoperculum. The width of the frontal bones between the eyes is about equal to the diameter of the orbit.

The preopercular spine is stout and directed obliquely backward and upward. The one below is small and pointed downward. On the inferior margin is another still smaller. The subopercular spine is moderate, acute, and directed forward.

The breadth of the isthmus separating the branchial apertures is equal to five-ninths of the length of the caudal fin. The branchiostegal bones are of the normal number of six.

The first dorsal has eight rays; the last is connected by a membrane decreasing in height to the second dorsal, where it is extremely low.

The anal fin has about the height of the second dorsal, and commences under its third ray.

The caudal forms between a fifth and sixth of the entire length. Its posterior margin, when fully expanded, is rounded; most of its rays are doubly bifurcated.

The pectorals extend backward to about the vertical of the sixth ray of the second dorsal; all of their rays are simple.

The radial formula is as follows:

D. VIII. 17; A. 13; P. 15; V. I. 4.

The lateral line, from the scapular bones to the end of the second dorsal fin, is well marked; it is then deflected and very obscure.

The color is grayish anteriorly and brownish posteriorly. It is covered with black spots, which, on the head and anterior portion of the body, are very small and numerous, but posteriorly are larger, confluent, and much fewer. The dorsal, caudal, and pectoral fins are quite thickly spotted on the rays; the rays of the anal have also a few spots. The ventrals are nearly immaculate.

This species is perhaps almost the only smooth American Uraneidid which can be at once readily distinguished. A single specimen was obtained by Dr. George Suckley, in the summer of 1859, between Bridger's Pass and Fort Bridger. It is four inches in length.

POTAMOCOTTUS CAROLINÆ, GILL.

By its general form, this species belongs to the group of which the *Potamocottus Richardsonii* is the type, and is nearly allied to that species.

The body is elongated, slender, and compressed. The head forms twenty-eight hundredths of the total length, and the caudal eighteen hundredths. The trunk is anteriorly subcylindrical, and its height equals the length of the caudal fin. The thickness at the base of the pectorals is as great or slightly greater than the height. From the region of greatest height, the body regularly declines to the caudal peduncle, whose height equals a third of the greatest. The breadth declines still more rapidly; at the anus, it is equal to little more than half of that at the base of the pectorals, or to a tenth of the total length.

The head is oval and depressed above. From the snout to the membranous opercular margin, it forms twenty-eight hundredths of the total length; its breadth is about a sixth less than the length. The profile, from the dorsal fin to the snout, is scarcely convex.

The mouth is large; the jaws arched and receding; the distance between the extremities of the maxillaries exceeds a sixth of the entire length, and nearly equals the length of the caudal fin. The maxillaries terminate under the posterior margin of the pupil. The upper jaw extends beyond the lower.

The jaws are armed with acute, curved, approximate teeth; the band on the intermaxillaries is almost entire, and extends with little diminution of width to the extremities of those bones. The band on the lower jaw is separated by a symphysial interval; it diminishes in width to the corners of the mouth. The vomerine and palatine bands are well developed, and about as large as that of the lower jaw.

The eyes are moderate, the longitudinal diameter of the orbit equaling a sixth of the head's greatest length. The distance between the center of the pupil and the snout equals a tenth of the entire length. The interorbital space is scarcely as great as the diameter of the orbit.

The preopercular spine is large, and curved upward; the two inferior are tubercular, the last one smallest. The subopercular spine is acute, and points obliquely forward and downward.

The interbranchial isthmus equals in width about four-ninths of the length of the caudal fin, or a twelfth of the total length.

The first dorsal has eight spines, and is connected with the second by a low membrane.

The anal fin commences under the third ray of the second dorsal.

The caudal fin forms eighteen hundredths of the total length.

The pectoral fins extend backward to the vertical of the third ray of the second dorsal fin; its median or fifth, sixth, and seventh rays are, in one specimen, on the left side, abnormally dichotomous; they are generally simple.

The longest ventral ray equals thirteen hundredths of the total length.

The number of rays and their arrangement are indicated by the formula—

D. VIII. 17; A. 12; P. 16; V. I. 4.

The lateral line is continued in an almost straight direction to the base of the caudal fin. The deflection under the end of the second dorsal is slight. The cutaneous keel in which the pores open is most developed posteriorly.

The color does not differ from that of the nearly allied species. There are four rather darker transverse dorsal bands, one under the first dorsal, two under the anterior and posterior parts of the second dorsal, and a fourth at the base of the caudal fin. The caudal fin and pectoral fins are banded or clouded with darker on the rays. The spinous dorsal is punctulated with darker, especially between the anterior rays. The remaining fins are hyaline. The head above is darker.

The *Potamocottus Carolinæ* is one of the largest species of the genus, and even exceeds the *Potamocottus punctulatus* Gill in size. It is most nearly allied to the *Potamocottus Richardsonii*, but slightly differs from it in the proportions of its parts, and more especially in the character of the lateral line. It is also found in a different hydrographical basin, the specimens described having been obtained by Prof. S. F. Baird, of the Smithsonian Institution, at Maysville, Ky., in the year 1852. They are now in the museum of the Smithsonian Institution, and numbered in the catalogue of fishes of the museum as 2859. The largest specimen is nearly six inches long.

SUBORDER EVENTOGNATHI, GILL.

FAMILY CYPRINOIDÆ, AGASS.

GENUS TIGOMA, GIRARD.

Synonymy.

TIGOMA *Girard*, Researches on Cyprinoid Fishes, &c., (p. 41, sep. copy) in Proceedings Academy of Natural Sciences of Philadelphia, vol. viii, p. 205, 1856.

The body is elongated-ovate or subfusiform in profile, and more or less compressed.

The scales are of moderate and nearly equal size on the different regions of the body. They extend forward to the nape and above the margin of the preoperculum.

The head is rather small, oblong-conical in profile, with a convex or subacuminate snout.

The eyes are of moderate size, and situated entirely in the anterior half of the head. The chain of suborbital bones is narrow.

The mouth is terminal, small or moderate, the maxillary bones ceasing under or near the anterior margins of the orbits; the periphery of the jaws is triangular, semi-elliptical, or oval.

The jaws are covered by thin lips; the lower lips are separated at the symphysis by a wide isthmus. There are no barbels.

The branchial apertures extend forward to or beyond the vertical of the preoperculum, and are separated by a rather narrow isthmus.

The dorsal fin commences near the posterior half of the body, or between the snout and end of median caudal rays. There are about twelve rays.

The anal is nearly intermediate between the bases of the ventral and caudal fins, and is of nearly the same size as the dorsal.

The pectoral fins are of moderate length, and their extremities are more or less rounded, and not acute.

The ventral fins are inserted under, or nearly under, the first rays of the dorsal fin; the first rays are of nearly equal length.

The pharyngeal bones are well developed, curved above, and with the peduncles rather long or moderate. The teeth are compressed and hooked, with or without a grinding-surface, and disposed normally, in two rows; the primary one has four or five teeth, and the secondary (or deciduous?) one or two.

This genus belongs to a group of genera of which the *Leuciscus* of Europe is the type, and it is indeed very closely related to that genus. *Algansea* of Girard is scarcely distinct, differing simply because of the pharyngeal teeth being confined to a single row; and it is by no means certain whether this is a true or permanent character. To this genus *Tigoma* also belongs the so-called *Cheonda cærulea* of Girard, which differs from *Cheonda Cooperi* (the type of the genus) by its narrow suborbitals.

TIGOMA SQUAMATA, Gill.

The body is robust and subovate, compressed, and very gradually diminishing in width toward the caudal fin. The dorsal and abdominal outlines are nearly equally arched. The greatest height of the body before the dorsal and ventral fins equal three-tenths of the length from the snout to the end of the median caudal rays, and is twice as great as the greatest width.

The caudal peduncle is rather slender, and narrowest between the anal and caudal fins; the distance between the anal fin and the base of the caudal equals eighteen hundredths of the total length; the height behind the anal twelve hundredths, and that of its most slender pair ten hundredths.

The head is conical in profile, acutely rounded anteriorly, and with the periphery of the jaws elongated semi-elliptical. The jaws are even; the maxillary bones end at the vertical of the anterior border of the eyes. The length of the head from the snout to the margin of the operculum forms more than a quarter (twenty-eight hundredths) of the entire length; the distance from the same place to the scaly nape exceeds a fifth of the length. The dorsal surface of the head is posteriorly flattened, and anteriorly becomes slightly convex; the outline of the naked portion is elongated subconical, and gradually decreases in width; posteriorly equaling fifteen hundredths of the total length, and anteriorly, from cheek to cheek, one-tenth being scarcely more than the interorbital space.

The eyes are of moderate size, circular, and entirely lateral, but near the profile; they are situated anterior to the plane separating the anterior and posterior halves of the head, the suborbital ring being half-way; the diameter of the eye exceeds a sixth of the head's length (five twenty-eighths), and the center of the pupil is distant two diameters from the muzzle.

The dorsal fin commences midway between the muzzle and end of the median caudal rays. Its base equals a ninth of the total length, its anterior rays fifteen hundredths, and its last more than six hundredths.

The anal fin commences between the sixth and seventh tenths of the length, is smaller than the dorsal fin, and the disproportion between the anterior and posterior rays is less. The base equals an eleventh of the length, the anterior rays thirteen hundredths, and the posterior more than seven hundredths.

The caudal fin is furcate, and its lobes equal; the median rays constitute a ninth of the total length, and the longest equal a fifth.

The pectoral fins are rounded, the third and fourth rays being longest; they equal sixteen hundredths of the total length.

The ventral fins are also rounded, and the third branched ray longest. They are inserted under the first branched ray of the dorsal; their length equals thirteen hundredths of the total.

The number and character of the rays are indicated by the following formula:

D. 4. 7 ÷ A. 4. 6 ÷ C. 9. I. 9. 8. I. 8; P. 1. 14; V. 1. 9.

All the simple rays of the dorsal and anal fins, except the fourth, are rudimentary.

The scales are of moderate size, and mostly suborbicular, with the nucleus subcentral, and with numerous radiating striæ. The lateral line runs through about fifty or fifty-five, and from the dorsal to the base of the ventral fins there are seventeen rows, ten of which are above and six below the lateral line.

The color is a dark purple or purplish-blue, with each scale margined with darker. The fins are of the same color as the body.

Specimens of this interesting new species were obtained by Mr. C. S. McCarthy, the collector of Captain Simpson's party, in the Salt Lake Basin of Utah. The species is readily distinguishable by the margination of the scales with a darker color.

GENUS PLATYGOBIO, GILL.

Synonymy.

POGONICHTHYS sp. *Girard,* Researches on Cyprinoid Fishes, (sep. copy, p. 24,) in Proceedings Academy of Natural Sciences of Philadelphia, vol. viii, p. 187, 1856.

The body is elongated, slender, and sub-fusiform, highest before the dorsal fin. The caudal peduncle is oblong and rather stout.

The scales are of large size, and nearly equal on the sides and front of the back; they advance forward nearly to the region above the vertical of the posterior margin of the preoperculum.

The head is small, forming about a fifth of the entire length; it is oblong-conical in profile, and the cranium is wide, the width of the occipital region being only about a third less than the length of the naked dorsal surface.

The snout is moderately depressed and prominent.

The eyes are of moderate size, lateral but superior, and entirely in the anterior half of the head.

The mouth is rather broad, but of moderate size, the maxillary bones ceasing under the anterior borders of the orbits; the lower closes within the upper. The lower lips are separated at the symphysis by a wide isthmus.

Barbels of moderate size are present at the angles of the mouth.

The branchial apertures extend forward to the vertical of the preoperculum, and are separated by a narrow isthmus.

The dorsal fin commences nearly midway between the snout and base of caudal. It is subquadrate, and has about ten rays; the first three are slender and spinous; the anterior spine rudimentary.

The anal fin is similar in size to the dorsal, and is intermediate between the bases of the ventral and caudal fins.

The pectoral fins are subfalciform, the first rays being longest.

The ventral fins are triangular, and situated under the dorsal fin. The axillary scales are elongated, but not pointed.

The caudal fin is forked and its lobes are equal.

The pharyngeal bones are rather stout and expanded at their angles; the peduncle quite short. The teeth are well developed, much compressed, and furnished with narrow grinding-surfaces; they are in a double row, four in the primary and one in the secondary.

The form which we have above characterized is at least as well entitled to a generic separation from the *Pogonichthys* as typified by the *Pogonichthys inæquilobus* of Girard as many of the genera of Cyprinoids distinguished by naturalists. The only species at present known to belong to the genus is that which has been described by Dr. Girard as *Pogonichthys communis.* From the other species of the genus *Pogonichthys*, it is distinguished by its broad and flattened head and muzzle, the very gradual decrease in width of the cranium, and the large scales. It is also worthy of note that all the typical *Pogonichthyes* are inhabitants of California, while the *Pogonichthys communis* is found in the country east of the Rocky Mountains.

The genus *Platygobio* belongs to a group of nearly allied genera, comprising especially *Gobio* of Cuvier, *Semotilus* of Rafinesque, *Pogonichthys* of Girard, and *Algoma* of Girard. Some of these genera have been widely removed from each other, but all of them appear to be very closely allied. It certainly cannot be in conformity with nature to place genera at almost extremes of the family simply on account of the presence or absence of barbels and the presence of one or two rows of pharyngeal teeth. Such are scarcely generic characters alone, and the latter character especially appears to be inconstant, the second row being perhaps deciduous. At least, there are fishes that have been placed in different genera on account of the presence or absence of the inner row of two or three small teeth, which can scarcely be even specifically, much less generically, distinguished. The barbels, being only tags of skin proceeding from the integument of the maxillary bones, have very little systematic value compared with the barbels, and especially the maxillary barbels of the Siluroids. As the above-mentioned differences are those only which have induced ichthyologists to distribute them, we have no hesitation in bringing the above-named genera together as closely-allied members of the same subfamily. *Algoma* was indeed placed by Dr. Girard among the *Chondrostomi*, but he was probably led to that act by the consideration of the single row of pharyngeal teeth and the absence of barbels, and not on account of the presence of a cartilaginous sheath enveloping the lower jaw. Girard has expressly stated that the sheath is not one of the essential characters of the group as understood by him. Bleeker was therefore incorrect in placing that genus in a group of which the presence of the cartilaginous sheath was the principal distinction.

The following appear to be the distinctive characters of the genera above enumerated:

The genus *Gobio* as admitted by Heckel has a compressed and gradually-narrowed head, with the dorsal surface transversely convex, and declining to the snout. *The ventral fins are under the anterior rays of the dorsal fin.* The scales are large, there being about forty in the typical species along the lateral line. The center of the eye is behind the middle of the head. There are well-developed maxillary barbels.

The genus *Semotilus* of Rafinesque has a head much like that of the *Gobiones*, but it is usually larger, and declines less toward the snout. The bases of the ventral fins are more anterior, being almost entirely *in advance of the dorsal fin.* The scales are comparatively small. The eyes are mostly or altogether in the anterior half of the head. The barbels are also somewhat smaller. The genus *Leucosomus* of Heckel and Girard is strictly identical with this.

In the genus *Pogonichthys* as now restricted, the head is small, compressed, and gradually narrowed to the snout; its dorsal surface is transversely convex, and declines quite rapidly to the prominent snout. The periphery of the jaws is elongated-semi-elliptical. *The ventral fins are under the middle of the dorsal.* The scales are of moderate or rather small size. The eyes are almost entirely situated in the anterior half of the head. The maxillary barbels are small.

The genus *Platygobio* is very nearly allied to *Pogonichthys*, but differs from it by its broader head, the width at the occiput being only about a third less than the naked portion of its dorsal surface; the scales are also larger.

Only one species of *Platygobio* is known. Numerous specimens were collected on Captain Simpson's expedition.

PLATYGOBIO COMMUNIS, GILL.

Synonymy.

POGONICHTHYS COMMUNIS *Girard*, Researches upon Cyprinoid Fishes, (sess. copy, p. 24,) in Proceedings of Academy of Natural Sciences, vol. viii, p. 188, 1856; Girard, Ichthyology of Pacific Railroad Reports, p. 247, pl. lv.

The body is elongated, compressed, and gradually decreases in breadth from the head to the caudal fin. The dorsal outline, anterior to the dorsal fin, is slightly curved to the nostril, and posteriorly nearly straight. The abdominal outline from the ventral fins to the snout is scarcely curved, and behind those fins is almost straight. The greatest height of the body immediately anterior to the dorsal fin equals a fifth of the total length from the snout to the *emarginated border* of the caudal fin, and is twice as great as the width at the same place.

The caudal peduncle is of moderate size, the distance between the posterior angle of the anal fin and the insertion of the caudal equaling fifteen hundredths of the total length, the height behind the anal, thirteen hundredths, and that at the base of the caudal eight hundredths.

The head is conical in profile, flattened and depressed above. The projecting, but flattened, muzzle is vertically rounded. The length of the head from the snout to the margin of the operculum forms a fifth of the total; the upper surface to the scaly nape equals three-fourths of the latter. The width behind equals a ninth of the total length, and at the pupil an eleventh.

The eyes are of moderate size, subcircular, entire, lateral, but near the plane of the superior surface of the head; they are situated entirely in the anterior half of the head, the distance of the pupil from the snout equaling two-fifths of the head's length, and the diameter of the eye itself a fifth of the same. The interorbital space is equal to an eleventh of the total length.

The dorsal fin commences between the fourth and fifth tenths of the total length from the snout, and is higher than long. The base equals a tenth of the total length; the longest ray fourteen hundredths, and the last eight hundredths.

The anal fin commences between the sixth and seventh tenths of the length from the head. Its size is less than that of the dorsal, the base equaling eight hundredths of the total length, the longest ray thirteen hundredths, and the last one seven hundredths.

The caudal fin is forked, and its lobes are equal. The central rays constitute an eighth of the total length, while the longest rays exceed a fifth of the same twenty-one hundredths.

The pectoral fins are emarginated or subfalciform; the longest rays equal a fifth of the length, and are four times longer than the shortest.

The ventral fins are inserted beneath the first rays of the dorsal; the external angles of their bases are distant from each other between six and seven hundredths of the total length. Each fin has a convex margin, and its longest ray equals an eighth of the whole length.

The radial formula is as follows:

$$\text{D. 3. 6. } \tfrac{1}{1}\text{; A. 3. 6. } \tfrac{1}{1}\text{; C. 4. I. 7. 8. I. 5; P. 1. 15; V. 2. 7.}$$

The first simple rays of all the fins, except the pectoral, are rudimentary.

The scales are of quite large size, there being about fifty perforated for the lateral line; under the dorsal fin, there are six rows above and seven below the lateral line. Each scale is oblong, or sometimes nearly as high as long, vertical at its base, and rounded behind; there are generally about ten diverging striæ.

The color is reddish-gray or blue on the dorsal region, and on the abdomen is whitish or whitish-yellow. The fins are uniform and colorless.

Numerous specimens of this fish were obtained by Mr. McCarthy, the collector of Captain Simpson's expedition, at Green River, Utah, and in the Platte Valley.

FAMILY SILUROIDÆ, (CUV.) BLEEKER.

SUBFAMILY PIMELODINÆ, (BON.).

Of this subfamily, there are found representatives of four genera and numerous species in the fresh waters of the United States. These have hitherto, with the exception of the *Noturi*, been referred to one genus, and for that genus the name of *Pimelodus* has been retained.

Now that the *Pimelodi* of Lacépède have been distributed among numerous smaller groups or genera, it remains to ascertain to what group the name *Pimelodus* ought to be restricted, and what names should be applied to the three genera now distinguished among the American *Pimelodinæ*, exclusive of the *Noturi* of Rafinesque.

Lacépède characterized his genus *Pimelodus* simply by the presence of an adipose fin, and included under the name the following species:

PREMIER SOUS-GENRE.

La nageoire de la queue fourchue ou ébranchée en croissant:

1. LE PIMELODE BAGRE, *Pimelodus bagrus* = *Bagrus* sp. Cuv. = *Galeichthys Gronovii* Val. = *Ælurichthys bagrus* B. & G.

2. LE PIMELODE CHAT, *Pimelodus felis* = *Silurus felis* Linn. partim. = *Amiurus* sp.*

3. LE PIMELODE SCHEILAN, *Pimelodus clarias* Lac. = *Synodontis clarias* Cuv. = *Synodontis arabi* Val. = *Synodontis schal* Bleeker.

4 LE PIMELODE BARRE, *Pimelodus fasciatus* = *Platystoma fasciatum* Ag. = *Sorubium fasciatum* Gill.

5. LE PIMELODE ASCITE, *Pimelodus ascita* = Embryonic young.

6. LE PIMELODE ARGENTÉ, *Pimelodus argenteus.* = *Bagrus Herzbergie* Val. = *Netuma Herzbergie* Bleeker.

7. LE PIMELODE NŒUD, *Pimelodus nodosus* = *Arius nodosus* Val. = *Auchenipterus furcatus* Val. = *Auchenipterus nodosus* Mull. & Trosch., Bleeker.

8. LE PIMÈLODE QUATRE-TACHES, *Pimelodus quadrimaculatus* = *Hemipimelodus quadrimaculatus* Bleeker.

9. LE PIMÈLODE BARBU, *Pimelodus barbus* = *Bagrus Commersonii* Val. = *Guiritinga Commersonii* Bleeker.

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* The *Pimelode chat* (*Pimelodus felis*) of Lacépède is chiefly founded on the *Silurus felis* of Linnæus, and the enumeration of the rays of the dorsal and anal fins is taken from the Systema Naturæ, but the mention of the color and partly of the habitat appears to be on the authority of Daubenton and Haüy and of Bonnaterre.

The *Silurus felis* of Linnæus, described on the authority of Dr. Garden as having six barbels and twenty-three anal rays, and as being allied to the *Silurus Catus*, can only be an *Amiurus*, whose nasal barbels have been overlooked. The species of the Encyclopedists described as being from Cayenne, where it is called *Machoiran blanc, Paisani,* and *Petit Gueule,* and whose color is white, is unrecognizable.

10. Le Pimèlode tacheté, *Pimelodus maculatus* Lac., Val. = *Rhamdia maculata* Bleeker = *Pimelodus maculatus* Lac.

11. Le Pimèlode bleuâtre, *Pimelodus cærulescens.*

This species is described as having two barbels above and two below, besides the supramaxillary ones. It cannot be referred with certainty to any known genus.

12. Le Pimèlode doigt-de-negre, *Pimelodus nigrodigitatus* = *Arius acutivelis* Val. = *Melanodactylus acutivelis* Bleeker = *Melanodactylus nigrodigitatus.*

13. Le Pimèlode Commersonien, *Pimelodus commersonii* = *Pimelodus barbus* Lac. = *Bagrus commersonii* Val. = *Guiritinga Commersonii* Bleeker.

14. Le Pimèlode Thunberg, *Pimelodus Thunberg* = *Silurus maculatus* Thunberg = *Silurus ocellatus* Bl., Schn. = *Arius ocellatus* Val., Bleeker = *Arius maculatus.*

15. Le Pimèlode maton, *Pimelodus catus* = *Pimelodus catus* Val. partim = *Amiurus catus* Gill partim.

16. Le Pimèlode cous, *Pimelodus cous* = *Arius cous* Heckel = New genus near *Glyptosternum cous.*

17. Le Pimèlode docmac, *Pimelodus docmac* = *Bogrus docmac* Cuv., Val., Bleeker.

18. Le Pimèlode bajad, *Pimelodus bajad* = *Bagrus bajad* Cuv., Val., Bleeker.

19. Le Pimèlode erythroptère, *Pimelodus erythropterus* = *Macrones erythropterus.*

20. Le Pimèlode raie-d'argent, *Pimelodus atherinoides* = *Pseudeutropius atherinoides* Bleeker.

21. Le Pimèlode rayé, *Pimelodus vittatus* = *Bagrus vittatus* Val., Bleeker = *Macrones vittatus.*

22. Le Pimèlode moucheté, *Pimelodus guttatus* = *Pimelodus ? guttatus* Bleeker = *Amiurus ? gutata* sp. incert.

SECONDE SOUS-GENRE.

La nageoire de la queue terminée par une ligne droite ou arrondie et sans échrancrure:

23. Le Pimèlode casque, *Pimelodus galeatus* = *Auchenipterus maculosus* Val. = *Trachycorystes* (?) *galeatus* Bleeker.

24. Le Pimèlode chili, *Pimelodus chilensis* = *Silurus chilensis* Linn.

In the year 1817, Cuvier published the first edition of his "Règne animal", and revised the class of Fishes. He formed a family for the *Siluri* and allied fishes, to which he gave the name of *Siluroides.* In this family, he admitted four great genera, *Silurus* Linn., *Malapterurus* Lac., *Aspredo* Linn., and *Loricaria* Linn. The *Siluri* were divided into five sections, the second of which was called that of the *Machoirans* or *Mystus.* The latter name was erroneously quoted as of Artedi and Linnæus in his first editions (Arted. et Lin. dans ses premières éditions); erroneously, for the name of *Mystus* does not occur as the designation of a genus in the special works of either of those naturalists.* It was first applied to a genus of Siluroids by Gronovius in the first part of his "Museum Ichthyologicum", where two species of the genus *Rhamdia* of Bleeker were referred to it. The name of *Mystus* would have to be then retained for that genus had it not been previously applied by Klein to a genus of Cyprinoids.

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* It is applied to species of the genus *Pimelodus* of Lacépède by Artedi in the great work of Seba (Locupletissimi Rerum naturalium Thesauri Accurata Descriptio et Iconibus artificiosis simus expressio per universam Physices historiam); but the third fasciculus, in which the fishes are described, was not published until long after the death of Artedi; and much has apparently been interpolated in that work of which that great ichthyologist was not the author.

The Cuvierian section of *Machoirans* included all those Siluroids which had two dorsal fins, the first of which was rayed and the second adipose. There were consequently referred to it the *Pimelodi*, *Ageneosi*, and *Dorades* of Lacépède. The *Machoirans* were again divided into groups, for which were retained the above names of Lacépède.

Finally, *Pimelodus* of Lacépède was itself taken with the limits assigned to it by its founder, and divided into three subgenera characterized by their dentition.

The first of these was *Synodontis* of Cuvier, which included the third species of the Lacépèdian genus *Pimelodus—Le Pimelode scheilan.*

For the second subgenus, the Lacépèdian name of *Pimelodus* was retained. It was intended to include those which had teeth only on the intermaxillaries and dentaries.

The third subgenus was named *Bagrus*, and included those which, in addition to the teeth on the jaws, had a parallel band on the vomer.

To that genus were referred the first,* fourth,† thirteenth,‡ seventeenth,§ and eighteenth|| species of Lacépède's genus *Pimelodus.* The ninth species of Lacépède** was considered as synonymous with his thirteenth. To illustrate the sequence and relative value assigned by Cuvier to his various groups, we subjoin the following extract from his methodical index:

MACHOIRANS (*Mystus* Artedi).
PIMELODES *Lacép.*
SHALS (*Synodontis* Cuv.).
PIMELODES PROPREMENT DITS (*Pimelodus* Cuv.).
BAGRES.
AGENEIOSES *Lacép.*
DORAS *Lacép.*

The next naturalist who circumscribed the genus was Rafinesque. That writer, in the "Ichthyologia Ohiensis", retained *Pimelodus* as the name of a genus, and the characters assigned by him to it were not essentially different from those of Lacépède; he added that the adipose fin is separated from the caudal. By that feature, he distinguished the genus from his *Noturi*, in which there is an "adipose fin very long, decurrent, and united with the tail".

The species of the Ohio referred to the genus so limited were placed in a subgenus called *Ictalurus*, which exactly corresponds to *Pimelodus* as restricted by Dr. Girard in the Report on the Ichthyology of the Pacific Railroad Surveys. The diagnosis of *Icta-*

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* *Pimelodus bagrus* Lac. = *Ailurichthys bagrus* Gill.

† *Pimelodus fasciatus* Lac. = *Sorubium fasciatum* Gill.

‡ *Pimelodus commersonii* Lac. = *Guiritinga commersonii* Bleeker.

§ *Pimelodus docmac* Lac. = *Bagrus docmac* Cuv.

|| *Pimelodus bayad* Lac. = *Bagrus bayad* Cuv.

** *Pimelodus barbus* Lac.

lurus given by Rafinesque is, perhaps, the best description of a genus given in his work, and is thought worthy of being copied:

"Head depressed, with eight barbs, one at each corner of the mouth, longer than the others, four under the chin, and two on the snout behind the nostrils. Teeth in two patches, acute and file-shaped. Pectoral fins and first dorsal fin armed with an anterior spine. First dorsal trapezoidal and before the abdominals; second opposite the anal. Body compressed behind, vent posterior and sub-medial. Operculum simple."

By the above limitation, the subgenus *Ictalurus* is seen to partly correspond with that of *Pimelodus* of Cuvier, the teeth being said to be in two patches or only on the jaws. By the description of the condition and position of the fins and the number of barbels, it includes only a small section of the Cuvierian subgenus.

The name *Ictalurus* must be then reserved for some of our Siluroids—for all, if they should be found to be congeneric—for a section, if it is ascertained that several genera are embraced under the subgenus.

Our studies of the Siluroids have convinced us that there are four natural genera found in the United States, three of which were included by Rafinesque in his subgenus *Ictalurus*, but placed at the same time in sections, which received from him various scientific names.

The sections established by Rafinesque were chiefly characterized by the form of the "tail" or caudal fin, and of the eyes, and the number of rays in the abdominal or ventral fins.

The first section was named *Elliops*, and included fishes with the "tail forked. Eyes elliptical. Abdominal fins with less than nine rays."

This group exists in nature, and is of generic value, but the characters given by Rafinesque are not those which essentially characterize it, nor can the name *Elliops* be retained for it.

The name given to a group as a whole must be preserved, and if that group is divided into sections, one of those sections must retain the name of the greater group In Rafinesque's system, *Ictalurus* is the greater group, and in it are included all the North American *Pimelodi*, with the exception of *Noturus*. When Rafinesque divided that group into sections, he should, therefore, have still retained that name for one of them. Such has not been done, but upon each of his sections was conferred another name. As this is in opposition to the rules of nomenclature, *Ictalurus* must be restored to one of his sections, and it is advisable to retain it for his first, and reject the name of *Elliops*. The section with this name is now accepted as a genus; its diagnosis will be hereafter given.

The name *Pimelodus*, it is true, was applied to all the *Ictaluri*, and by that name only are they called. If *Pimelodus* had been of Rafinesque's creation, that name should, therefore, have been adopted; but as Rafinesque has only taken it from Lacépède, with the characters given to it by its founder, it is to be supposed that he intended it to be otherwise restricted. It appears to us that it is no valid argument against the acceptation of Rafinesque's names for genera, if his sections should prove to be such, that he did not apply them specifically.

The section called *Elliops*, on comparison with its type *Pimelodus cœrulescens* of

Rafinesque (not Lacépède), has been found to be identical with *Synechoglanis* of Gill. The most essential characteristics of that genus had been omitted by the former naturalists who had described its species. The present author, not willing to believe that such was the case, although recognizing the similarity of external appearance between the type of *Synechoglanis* and the *Pimelodus cœrulescens,* described it under the new generic name. When an opportunity was at length offered to examine species of the group typified by *Pimelodus cœrulescens,* its generic identity with *Synechoglanis* was evident. We have, therefore, renounced our own name, under which the genus was first truly characterized, and adopt the prior designation of Rafinesque, but, instead of *Elliops,* take the name *Ictalurus,* as previously mentioned.

This second section of Rafinesque's *Ictaluri* was named *Leptops,* and is characterized by the "tail bilobed. Eyes round and very small. Nine abdominal rays Vent posterior. Adipose fins large."

In this section, two nominal species were included, the *Pimelodus viscosus* of Rafinesque and his *Pimelodus nebulosus.* The latter was "said to be totally different from the foregoing, and might perhaps form a peculiar section or even subgenus (*Opladelus*), by the conical head, membranaceous operculum, but particularly, because the first rays of all the fins, except the caudal and adipose, is a kind of soft obtuse spine concealed under the fleshy cover of the fins."

Rafinesque's assertion that his *Pimelodus nebulosus* was "totally different" from the *Pimelodus viscosus* has neither been substantiated by his own description, nor by the observations and explorations of Dr. Kirtland in the same waters as those in which Rafinesque himself pursued his investigations. The *Pimelodus nebulosus* and *viscosus* were doubtless varieties of the same species. The descriptions are mutually applicable to each other, except in those cases where the characters given are evidently fictitious or erroneous, which, indeed, are very frequent.

Rafinesque's fourth section is founded on a species, which, according to Dr. Kirtland, is the adult of the *Pimelodus viscosus* of Rafinesque. The section is characterized as having the "Tail entire, eyes elliptical. Nine abdominal rays. Dorsal fins submedial. Pectoral fins with one flat spine serrated outwards and nine rays. Lower jaw longer."

The only species of this section was named *Pimelodus limosus.* The section in question was designated by the name *Ilictis.* The name, however, should have been spelled *Ilyichthys,* in accordance with its thymology and the rule observable for the composition of names.

Rafinesque has named "a genus" *Pylodictis,* which appears to have been also founded on the same fish that had already been three times indicated in his work. The fictitious genus and species were established only on the evidence of a drawing by Mr. Audubon, of a fish "found in the lower parts of the Ohio and in the Mississippi". That drawing, according to Rafinesque, represented a rayed fin instead of the usual adipose dorsal. Such a feature would be in opposition to that general plan on which naked Siluroids with two dorsals are constructed,* and it is therefore certain that Audubon had erroneously represented the species, or that the drawing had been wrongfully interpreted by Rafinesque. It is also stated that there is no lateral line. This statement is as certainly false as the other. The remainder of the description applies better to the *Pimelodus* or *Hoplodelus limosus* than to any other Siluroid of the Ohio.

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* The genus *Phractocephalus* of Agassiz forms no exception to this. A mistake similar to that made by Audubon or Rafinesque occurs in the great work on Brazilian Fishes of Spix and Agassiz. A species is figured in the plates under

The generic diagnosis of Rafinesque describes the "Body scaleless, conical flattened forwards and compressed behind. Head very broad and flat with barbs, eyes above the head. Two dorsal fins, both with soft rays. Vent posterior."

The numbers of the rays of the fins are not given; but the description of the form of the body and head, the position of the vent, the color, and we may even add the popular name attributed to it, leave no room for doubt as to at least the generic identity of the *Pylodictis limosus* with the *Hopladelus limosus*

Another section, and the last one to be mentioned, into which Rafinesque divided the *Ictaluri*, was placed as the third, and named *Ameiurus*. His generic characters are the following:

"Tail entire. Eyes round. Eight abdominal rays. Vent posterior. Dorsal fin anterior with a spine. Lower jaw not longer. Pectoral fins with one simple spine and seven rays."

This section corresponds to the restricted genus of which the common *Pimelodus catus* and *Pimelodus Dekayi* are the well-known representatives. Rafinesque refers to the section four species which appear to be truly congeneric. Dr. Kirtland, in his "Descriptions of the Fishes of Lake Erie, the Ohio River, and their tributaries," refers to only one of these—the *Pimelodus cupreus*. If we can rely upon the description of Rafinesque, the *Pimelodus lividus* was not known to Dr. Kirtland. It may, however, be the species described by that naturalist as *Pimelodus catus*. There is little doubt that the same is the case with the *Pimelodus melas*. The *Pimelodus xanthrocephalus*, on the other hand, appears to be only a variety of the *Pimelodus cupreus* of the same author.

In identifying the species of Rafinesque, we must, however, bear in mind that his descriptions are generally so inaccurate or vague that of many of them we can never be certain, and we can only have an approximate idea when the zoology of those places which were so unfortunate as to receive his attention has been exhausted. That unhappy man had, nevertheless, a keen appreciation of natural affinities; and had he been less aberrant, he would have ranked far ahead of most of the naturalists of his day.

As to the application of the name *Pimelodus*, it would appear necessary to reserve it for one of those species referred to it by Lacépède which has not been placed in other genera or groups, and which has been retained in the genus by its last monographer.

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the name of *Heterobranchus sextentaculatus*. It has a long second dorsal, which appears to be furnished with true rays. On this character, Mr. Swainson has founded his genus *Pteronotus*, and, totally deceived as to its affinities, has placed it between the genera *Phractocephalus* of Agassiz and *Sorubium* of Spix in his subfamily of *Sorubinæ;* that group is separated by the subfamilies *Aspredinæ* (composed of true *Aspredinidæ* and of *Eremophili*), and the *Silurinæ* from the subfamily *Pimelodinæ;* both of the latter groups are also composed of genera arranged in a fantastical and unnatural manner. All of the characters of the *Heterobranchus sextentaculatus* indicate its affinity with the *Pimelodinæ*, and it is indeed a true *Pimelodus* of Cuvier and Valenciennes, and, according to the latter, is identical with his *Pimelodus Sebæ*, and consequently belongs to the genus *Rhamdia* of Bleeker, or *Pimelonotus* of Gill. The last two names were published nearly simultaneously, but Bleeker's has probably the priority. Swainson's name could not be accepted, even if correctly applied, as it has been previously given to a valid genus of *Chiroptera*.

The restriction of Cuvier will exclude its application to any except those with teeth only on the jaws.

Rafinesque having conferred a name on those species which had eight barbels, and teeth on the jaws only, the name is excluded from application to any of them.

Subsequent authors have separated other forms referred by Lacépède to the genus. The only species that remained after them, which was not covered by the generic characters of the species separated from *Pimelodus*, was the *Pimelodus maculatus*. For that species the generic name *Pimelodus* must be then retained. That species has been referred by Dr. Bleeker, in his recently-published monograph of the *Silurii*, to a genus to which he has given the name *Rhamdia*, and which had nearly simultaneously, but probably somewhat later, received from myself the name of *Pimelonotus*. As the *Pimelodus maculatus* appears to be generically distinct from the *Pimelodus Sebæ*, the type of the genus *Rhambia*, both names may still be retained.

ICTALURI, GILL.

The body is more or less elongated, compressed posteriorly, and terminated by a well-developed caudal fin. The skin is naked and unprovided with sucking-cups.

The head in profile presents the appearance of a more or less elongated cone, and is covered by a skin which is generally quite thick. It is more or less flattened and broad above, and gradually becomes narrowed to the convex snout. There is never a casque, or helmet. The supra-occipital terminates in a point.

There are eight barbels: the two maxillary constant in the family, a pair in front of the posterior nasal apertures, and two pairs arranged in a curved line behind the lower jaw.

The nostrils form nearly a transverse parallelogram between the intermaxillaries and the eyes; the anterior are suboval or subcircular, and the posterior linear, with a raised margin, from the front of which the upper barbels originate.

The eyes are generally placed in the anterior half of the head.

The branchial apertures are ample, continued from the supero-posterior angles of the opercula to beneath the throat.

ICTALURUS, (RAF.) GILL.

Synonymy.

ICTALURUS *Raf.* Ichthyologia Ohiensis, p. 61.
ELLIOPS *Raf.* Ichthyologia Ohiensis, p. 62.
SYNECHOGLANIS *Gill*, Annals Lyceum of Nat. Hist. of New York, vol. VII, p. 39.
PIMELODUS sp. *Kirtland, auct.*

Body elongated, slender, and much compressed. The caudal peduncle is short but slender, and presents behind the anal an elongated elliptical section.

Head conical in profile, compressed, and with the sides posteriorly sloping downward and outward. The supra-occipital is prolonged backward, and its emarginated apex receives the acuminate anterior point of the second interspinal. The skull is covered by a thin tense skin, through which the sculpture of the bones is apparent.

Eyes large and almost entirely lateral.

Mouth moderate or small, transverse, and terminal. The upper jaw generally protrudes beyond the lower.

Teeth subulate and aggregated in a short laterally-truncated band on each jaw.

Branchiostegal rays eight or nine.

Dorsal fin situated over the interval between the pectoral and ventral fins, higher than long, with one spinous and six articulated rays.

Adipose fin pedunculated and over the posterior portion of the anal.

Anal fin long, and provided with twenty-five to thirty or more rays; it commences near the anus.

Ventral fins provided each with one simple and seven branched rays.

Caudal fin elongated and quite deeply forked, with the lobes equal and pointed.

The genus *Ictalurus* is at once recognized by its forked caudal fin, and its compressed, elongated, and slender body, which gives to it a peculiarly graceful appearance, very unlike that of the stout, obese, and large-headed catfish of our Eastern and Middle States. The head is smaller in proportion than in the *Amiuri*, more compressed, and not covered by so thick a skin; the mouth, as we should naturally expect, is also very considerably smaller. But perhaps the most important distinction resides in the mode of insertion of the supra-occipital or interparietal bone into the head of the second interspinal. A firm and immovable bridge is thus formed, and gives an uninterrupted passage from the dorsal fin to the snout.

ICTALURUS SIMPSONII, GILL.

The body is slender, elongated, and compressed; the height is greatest at the dorsal fin; it is there equal to between a fifth and sixth of the total length from the snout to the concave margin of the caudal; thence it gradually declines for some distance, more rapidly as it approaches the end of the anal fin, the dorsal and especially the abdominal outlines over the anal fin being slightly curved. The caudal peduncle is least high near the middle, where it equals a twelfth of the total length. The greatest thickness is at the bases of the pectoral fins, and is about eight-ninths of the height; thence it quite regularly diminishes to the compressed and thin base of the caudal fin.

The head is compressed, and presents in profile an oblong-conical form; from the projecting snout to the margin of the bony operculum it forms twenty-two hundredths of the total length, exclusive of the lobes of the caudal fin. The height, at the vertical of the margin of the operculum, nearly equals a sixth of the total length, and bears the relation to the length of the head of fifteen to twenty-two. The head above is oblong and nearly regularly decreases in width from the pectorals to the snout; at the vertical of the eyes, it equals three-quarters of the greatest width, and the bony interorbital space only equals three-eighths of the same. The head above is transversely arched posteriorly, and beneath is flat.

The eyes are large and oval, mostly situated in the anterior half of the head on the sides. The largest diameter is between a fifth and sixth of the head's length; the interorbital space is double the diameter.

The maxillary barbels are slender, and extend beyond the opercula. The nasal barbels are very slender, and are scarcely longer than the diameter of the eye. The infra-maxillary barbels are in a curved line nearly parallel with the jaw; the external ones exceed half the length of the maxillary, and are twice as long as the internal infra-maxillary ones.

The branchiostegal rays are enveloped in a thick skin; there are eight, of which the two internal are flattened and largest; the rest are slender, and rapidly decrease in length. The branchiostegal membrane is deeply excavated, and is attached to the throat for about half the interval between the mental fold and the bottom of the emargination of the membrane; the mental fold is itself midway between the emargination and the lower jaw.

The dorsal fin commences at a third of the distance from the snout to the concave margin of the caudal fin; its base equals a fourteenth of the total length, and is scarcly half its height. The spine is slender, and about three-fourths of the length of the longest ray; its posterior margin is nearly edentulous, having but two or three tubercles on the posterior half.

The adipose fin is elongated and falciform, and nearly equals in length (or height) the base of the first dorsal; its base is over the penultimate rays of the anal fin.

The anal fin commences at the fifty-six hundredths of the distance between the snout and the concave margin of the caudal fin; it is situated one twenty-fifth of the same length behind the anus. Its base is more than a fifth of the length of the fish; its greatest height anteriorly (as well as can be judged from the imperfect specimens before us) is somewhat greater than an eighth of the total length, and above two and a half times greater than that of the posterior rays.

The pectoral fins have each a strong compressed spine, smooth on the external margin, and armed with strong teeth directed downward on the internal one. The length is equal to thirteen hundredths of the total length, and that of the first articulated and longest ray to fifteen hundredths. The process of the coracoid bone projects beyond the base of the pectoral spine for a distance equal to the interval between the snout and orbit. The ventrals commence between the fourth and fifth tenths of the length; their length somewhat exceeds a tenth of the total. The second and third rays are longest.

The caudal fin is deeply forked, the longest ray being at least twice as long as the central ones; the latter form a ninth of the total length. The base of the fin is convex. The rudimentary rays advance comparatively little on the superior and inferior faces of the peduncle.

The number of rays is as follows:

$$\text{D. I. 5. } \tfrac{1}{1}\text{; A. 2. 4; P. I. 9; V. 1. 7.}$$

The color of the shrunk alcoholic specimen is purplish-brown above and silvery-bronze on the sides. The free half of the anal fin is darker.

This species is very nearly allied to several of its congeners of the western streams and rivers, but appears to differ from all of them. From the *Ictalurus cœrulescens* (*Pimelodus cœrulescens* Raf.) and *Ictalurus affinis* (*Pimelodus affinis* Girard), it is at once distinguishable by the fewer rays of the anal fin, there being about thirty rays in that of the former and thirty-five in that of the latter. The distinction from the *Ictalurus olivaceus* (*Pimelodus olivaceus* Girard) and *Ictalurus vulpes* (*Pimelodus vulpes*

Girard) appears to be less tangible. As we have not, at present, access to the specimens on which the latter species are based, we have to rely on the descriptions and figures of their describer. As these are not very satisfactory, we are prevented from entering into minute comparison. We can only state that our present species appears to differ from the former by the longer head, the shorter nasal barbels, and the absence of true serration on the posterior face of the dorsal spine. With the *Ictalurus vulpes* it appears to also disagree by the presence of a larger head and a less deeply-forked caudal fin. Other differences will doubtless be found on comparison. It may, nevertheless, be possibly a mere variety of the *Ictalurus olivaceus*. This can only be ascertained by an autoptical examination.

Two specimens of this species, not in any essential respect differing from each other, were obtained by Dr. Suckley in the Big Sandy River of Kansas.

AMIURUS, (RAF.) GILL.

Synonymy.

AMEIURUS *Raf.* Ichthyologia Ohiensis, p. 65.
ICTALURUS sp. *Raf.* Ichthyologia Ohiensis.
PIMELODUS sp. *auct.*

Body moderately elongated, robust, anteriorly vertically ovate and scarcely compressed. The caudal peduncle is also robust, but much compressed, and at its end equally convex.

Head large, wide, and laterally expanded; above ovate, and in profile cuneiform. The supra-occipital is extended little posteriorly, and terminates in a more or less acute point, which is entirely separated from the second interspinal buckler. The skin covering the bones is thick.

Eyes small or moderate.

Mouth terminal, large, transverse; upper jaw generally projecting beyond the lower.

Teeth subulate or acicular, aggregated in broad bands on the intermaxillaries and dentaries. The intermaxillary band is convex in front, of equal breadth, and abruptly truncated near the insertion of the maxillaries. The lower dental band is anteriorly semicircular, attenuated to the angles of the mouth.

Branchiostegal membrane on each side with from eight to nine rays.

Dorsal situated over the interval between the pectorals and ventrals, higher than long, with pungent spinous ray posteriorly dentated, and six branched ones.

Adipose fin short, and inserted over the posterior half of the anal.

Anal fin of moderate length, commencing within a short distance of the anus, and generally provided with from twenty to twenty-five rays.

The caudal fin is short, with a margin sometimes convex, and sometimes truncate or scarcely emarginate.

Ventrals, each with one simple and seven branched rays.

This genus includes our common Eastern American catfishes, and is readily recognized by the broad head covered by a thick skin, the free termination of the posterior process of the supra-occipital bone, the compressed body, and the slightly emarginate or even convex caudal fin, which is not connected with the adipose dorsal.

AMIURUS OBESUS, Gill.

The body is comparatively short and robust. The greatest height exceeds a fifth of the total length from snout to margin of caudal. The least height of the caudal peduncle equals a tenth of the length. The greatest thickness at the bases of the pectoral fins exceeds a fifth of the length.

The head is almost semi-conical in profile, and is above oval and depressed, and declines in nearly a straight line from the dorsal fin to the snout. From the snout to the bony margin of the operculum, it forms a quarter of the extreme length. The greatest width exceeds a fifth of the total length; the width between the cheeks, under the eyes, equals eighteen hundredths of the same. The interval between the borders of the eyes exceeds thirteen hundredths.

The eyes are small and covered with adipose matter; the diameter of one is equal to about an eighth of the length of the head; they are separated from the middle of the snout by more than a tenth of the total length.

The maxillary barbels are slender and extend little beyond the bases of the pectorals. The nasal barbels extend beyond the posterior borders of the eyes. The infra-maxillary are arranged on a curved line parallel with the lower jaw. The external are little longer than the internal, the former about equal the interval between the eyes; the distance between the bases of the two internal exceeds by about a fourth that between the internal and external of one side.

The branchiostegal rays are enveloped in a thick skin; there are nine, the two upper of which are large and compressed. The branchiostegal membrane is deeply excavated, and, as in all the *Ictaluri*, when closed, or not expanded, appears anteriorly as a simple fissure or fold; the mental fold is much nearer the bottom of the emargination than the jaw. The membrane itself is attached for nearly half the distance between the fold and the emargination.

The dorsal fin commences scarcely behind the end of the first third of the length; its length nearly equals a twelfth of the length, as does also that of the spine; its height is about a seventh of the length.

The adipose fin is semi-cordiform.

The anal fin commences at the fifty-four hundredths part of the distance between the snout and end of caudal; its length equals a seventh of the total length, and its height less than a thirteenth; it rapidly increases in height in front, and as rapidly decreases behind.

The pectoral fins are short, their length little exceeding a seventh of the total; the spine equals an eleventh of the length, is moderately stout, externally edentulous, and internally toothed.

The process of the coracoid bone is spiniform, and from the base of the pectoral spine equals seven ninths of its length.

The ventral fins commence slightly behind the fourth tenth of the length; they equal a seventh of the length. The third ray is the longest.

The caudal fin, when expanded, appears to be truncated, and forms fifteen hundredths of the total length.

D. I. $4\frac{1}{1}$; A. 4. 13. $\frac{1}{1}$; C. 7. 1. 15. 1. 9; P. I. 8; V. 1. 7.

The color, in spirits, is olivaceous on the head and body above and laterally, and below and on the abdomen whitish. The membrane between the rays of all the fins is blackish, while the rays themselves are light. The bases of the anal and caudal fins are reddish. The teeth are of a dark-purplish color.

Two specimens of this species were obtained on Captain Simpson's expedition by Mr. McCarthy. The precise locality is not known; but it is supposed that they were obtained in Nebraska.

NOTURUS, Raf.

Synonymy.

NOTURUS *Raf.* American Monthly Magazine and Critical Review, vol. iv, p. 41, Nov., 1818.

NOTURUS *Raf.* Prodrome de soizante-dix nouveaux Genres d'Animaux découverts dans l'intérieur des États-Unis en 1818 *in* Journal de Physique, vol. lxxxviii, p. 421, June, 1819.

NOTURUS *Raf.* Ichthyologia Ohiensis, or Natural History of the Fishes inhabiting the River Ohio and its tributary streams, p. 67; ib. in Western Review and Miscellaneous Magazine, vol. —, p. 361, July, 1820.

NOTURUS *Baird*, Iconographic Encyclopædia of Science, Literature, and Art, vol. i, Zoölogy, p. 216.

SCHILBEOIDES *Bleeker*, Ichthyologiæ Archipelagi Indici Prodromus, vol. i, Siluri (Acta Societatis Scientiarum Indo-Nederlandicæ, vol. iv), p. 258.

SILURUS sp. *Mitchill*, American Monthly Magazine and Critical Review, vol. i, p. 289, and vol. ii, p. 322.

Body moderately elongated, anteriorly subcylindrical, and thence more or less compressed.

Head large, elongated, conic or cuneiform in profile, above ovate and depressed, with a slight longitudinal furrow, branching into a transverse depression on the nape. The skin is very thick, and entirely conceals the bones. The supra-occipital has no connection with the head of the second interspinal.

Eyes of small or moderate size.

Mouth anterior, large, and transverse. The upper jaw projects beyond the lower.

Teeth subulate, and closely aggregated in a broad band in each jaw, which, in the lower one, is interrupted by a linear interval, and in the upper one is continuous; the band of the upper jaw is either abruptly truncated at each end, or prolonged backward by a continuation from the postero-external angle. The lower band is, as usual, attenuated toward the corners of the mouth.

Branchiostegal membrane with nine rays on each side.

Dorsal fin situated over the posterior half of the interval between the pectoral and ventral fins, with a very pungent, short, edentulous spine, and seven branched rays.

Adipose fin long and low, connected with the accessory rays of the caudal fin, and not forming a separate fin.

Caudal fin very obliquely truncate or rounded, and inserted on an equally obliquely rounded base; the rays rapidly decrease in length inferiorly, and there are numerous rudimentary ones, both above the caudal peduncle, where the anterior is united to the adipose fin and forms a continuous keel, and below, where they advance considerably forwards.

The anal fin is comparatively short, and rapidly increases in height for the first half of its length.

The ventrals are rounded, and each has one simple and eight branched rays.

The anus is situated some distance in advance of the anal fin.

The *Noturi* are at once recognized by the peculiarly-formed caudal fin and its oblique insertion on the peduncle, and by the ovate head, with the transversely-depressed nape and median longitudinal groove.

For our earliest information of a species of this genus, we are indebted to Dr. Samuel L. Mitchill; but the description of that naturalist is incorrect, or, at least, his interpretation of the characters observed is erroneous. Subsequent naturalists have, therefore, been much deceived as to its affinities.

The principal error in Mitchill's description is the assertion of the absence of an adipose fin. But this statement is readily reconciled with the features of *Noturus* when it is remembered how low that fin is, and how it unites with the caudal. Mitchill drew attention to the peculiarity of the caudal, and described it as commencing an inch behind the dorsal fin, and thence "continued quite round the tail, and almost to the anal fin. The form is lanceolated and pointed," and "it may be compared to the tail of an eel; the resemblance is nearer to that of a tadpole, when it approaches the period of conversion to a frog." The peculiarities thus noticed and the rest of Mitchill's description leave no doubt as to the true affinities of the *Silurus gyrinus*, and as to the correctness of Rafinesque in afterward referring it to his genus *Noturus*.

Mitchill observed that "the want of serræ to the spines, and of a second dorsal might lead some to remove this fish from the *Siluri* family; but to avoid needless innovation, I retain him here." Mitchill, when inditing that remark, must have forgotten that the type of *Silurus* was without an adipose fin, and that the presence of such a fin was consequently an exceptional rather than a normal character of the Linnæan genus, although the greater portion of its species were provided with it. The want of serræ to the spines is not of as much value as Mitchill supposed.

Dr. De Kay, in his Fauna of New York, introduced Mitchill's description of *Silurus gyrinus* at the end of the *suite* of the *Pimelodi* of the State described in his work, and remarked that "on account of its dorsal spine it cannot be admitted into that genus" (*Silurus* Val.); and the same spine being smooth, and not serrated, excludes it from *Schilbe.* Its natural position in a general arrangement of the *Siluridæ* would seem to be between *Schilbe* and *Cetopsis*, forming a passage, by its simply spinous anterior dorsal and pectoral ray, from one to the other. It may be thus characterized: "No adipose fin; simple spines to the dorsal and pectoral; anal long; caudal pointed, not united to the anal." Important details respecting the teeth are wanting to complete the character.

Having already noticed the true relationship of *Silurus gyrinus*, it necessarily follows that there is no near affinity between it and the genera noticed by De Kay.

The description of Mitchill and the remarks of Dr. De Kay have also led Dr. Bleeker into error. That learned ichthyologist, in his Monograph of the *Siluri*, has formed a distinct genus for the *Silurus gyrinus*, which he has named *Schilbeodes*, and which is interposed between *Hematogenys* of Girard and *Trichomycterus* of Cuvier and Valenciennes, in the subfamily of *Silurichthyoidei* and the group of *Trichomycterini*. Bleeker's generic characters are the following:

"*Schilbeodes* Bleeker.* Pinna dorsalis caudali quam capiti approximata; analis caudali contigua. Cirri 8."

The diagnosis relating to the dorsal fin is erroneous. Mitchill not having mentioned the position of that fin, Bleeker must have assumed that the caudal was not much more than normally extended on the dorsal region of the peduncle, and, noticing the statement concerning the commencement of the fin an inch behind the dorsal, was thus misled. The remarks we have made on De Kay's allocation of the species apply equally to Bleeker's.

The publication of Rafinesque's diagnosis of the genus *Noturus* soon succeeded Mitchill's description of his *Silurus gyrinus.* Rafinesque's first notice of his genus is to be found in volume fourth of the "American Monthly Magazine and Critical Review". It is there said to "differ from *Silurus* by having the second dorsal connected with the tail, or forming a single fin". The description of the single species (*Noturus flavus*) refers only to the color, the caudal fin, lateral line, superior length of upper jaw, the barbels, and the number of rays, most of which are generic characters. Rafinesque's next description occurs in his "Prodrome de soixante dix nouveaux genres d'animaux, &c.", and is substantially the same as that in the Magazine. As the work in which the "Prodrome" is published is inaccessible to most American students, we add the description in a note.* The name of the species is changed by Rafinesque to *Noturus luteus.* The genus is for the third time described by Rafinesque in the "Ichthyologia Ohiensis". It is there said to "differ from the genus *Plotosus* of Lacépède by having the anal fin free", although there is really no connection between the two genera. The remainder of the description differs little from those previously noticed. The specific name of *Noturus flavus* is restored to the species.

NOTURUS OCCIDENTALIS, GILL.

The greatest height is equal to nearly a sixth of the total length, and less than the greatest breadth outside of the bases of the pectorals. The height of the caudal peduncle behind the anal fin slightly exceeds a tenth of the length.

The head is subcuneiform in profile, and above presents an oval form; at the cheeks behind the eyes it appears to be swollen. The length of the head enters less than four times (0.23) in the total length. The breadth at the opercula nearly equals a fifth of the entire length; that between the cheeks behind the eyes is about the same.

The distance between the eyes equals a tenth of the length, and is of nearly the same extent as that between each eye and the middle of the snout. The eyes themselves are small, a diameter not much exceeding a seventh of the head's length.

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* Bleeker's work not being readily accessible to American students, we extract his remarks in Dutch, which, we must again remind the reader, are founded on error.

"Silurus gyrinus, door Mitchill en 1818 reeds kortelijk doch onvoldoende beschreven, korut mij voor tot de Trichomycterini te behooven. De rugvin schijnt er sell rodert bij de stoortvin te zijn don bij den kop en de aarsvin zon en zeer nabij de stoart vin eindigen. Overigens 8 voeldroden, 7 rugvin en 16 aarsvinstralen. Misscheen een midden vorm tusschen Trichomycterus en Nematogenys."

* 18. NOTURUS. (Abdominal) diffèrent des genres *Silurus* et *Pimelodus* par nageoire caudale décurrente sur le dos jusque vis-à-vis l'anus, et tenant lieu de deux nageoires dorsales adipeuses. *N. luteus,* corps conique comprimée, tête déprimée, 8 barbillons, mâchoire supérieure plus longue, nageoires dorsale et pectorales, queue tronquée, ligne latérale presque droite, couleur entièrement jaunâtre. D. 7; A. 14; P. 7; Abd. 8. C'est une petite espèce: les barbillons sont disposés comme dans les Pimelodes de l'Ohio. Le *Silurus gyrinus* de Mitchill est une autre espèce de ce genre.

The maxillary barbels are slender and scarcely attain to the bases of the pectorals. The nasal barbels extend slightly behind the eyes. The inframaxillary are arranged on a curved line parallel with the jaw; the internal are much more distant from each other than those of one side; the external are about a tenth of the total length; the internal about six or seven tenths as long as the external.

The band of teeth on the intermaxillaries is extended backward from the angles into a point.

There are nine branchiostegal rays concealed in a very thick membrane. The bottom of the sinus of the membrane is very near the mental, the fold being nearly at the end of the third fourth of the distance between the lower jaw and the sinus.

The dorsal fin commences at the beginning of the third tenth of the distance from the snout to the end of the caudal fin. Its length equals a tenth of the length, and is little less long than high. The spine is small and simple, and its length scarcely equal half that of the fin.

The adipose fin is low and thin, begins nearly over the sixth or seventh ray of the anal, and appears, in the single specimen before us at least, to have separated from the accessory rays by a naked interval.

The anal fin commences at the end of the eleventh twentieth of the distance between the snout and end of caudal fin. Its length is not quite equal to a sixth of the total length; it rapidly increases in height toward the middle, where it somewhat exceeds an eleventh of the extreme length. The last rays rapidly decrease in size.

The pectoral fins equal in length an eighth of the total; each has a spine, which enters about eleven times in the length, and which is smooth internally, but on its external border has long serræ. The margin of the fin is rounded.

The coracoid spine is short, stout, and oblique.

The ventral fins commence behind the end of the fourth tenth of the length; each has a length equal to a tenth of the extreme.

The caudal fin is oblong, gradually and obliquely narrowed to the end, which appears to have been nearly truncated.

The supernumerary rays are numerous and well developed, the distance from the anterior to the end of the peduncle being almost as great as the length of the longest rays.

The number and arrangement of the rays is expressed by the following formula:

D. I. 6. $\frac{1}{1}$; A. 4. 11. $\frac{1}{1}$; C. 23. 7. 12. 11; P. I. 10; V. 1. 8.

The color of the single ill-preserved specimen is an olivaceous-brown, light beneath, and with the fins not margined by a darker color.

This species of *Noturus* was collected by Dr. Suckley in the Platte River. It is interesting as being a species of a genus which does not appear to be rich in representatives, and as coming from a more western locality than any other.

HOPLADELUS, (RAF.) GILL.

Synonymy.

GLANIS *Raf.* MSS. American Monthly Magazine and Critical Review, vol. iv.
LEPTOPS *Raf.* Ichthyologia Ohiensis, p. 64.
OPLADELUS *Raf.* Ichthyologia Ohiensis, p. 64.
ILICTIS *Raf.* Ichthyologia Ohiensis, p. 66.
PYLODICTIS *Raf.* Ichthyologia Ohiensis, p. 67.
ICTALURUS sp. *Raf.*
PIMELODUS sp. *Kirtland*, auct.

The body is much elongated, and presents in profile a very slender appearance. It is much depressed, and is anteriorly broader than high.

The head is large, very wide and depressed, laterally expanded, above broadly ovate, and in profile cuneiform. The skin is very thick and entirely conceals the skull. The supra-occipital bone is entirely free from the head of the second interspinal.

The eyes are small.

The mouth is large, anterior, and transverse. The lower jaw projects beyond the upper.

The teeth are in broad villiform bands on the intermaxillaries and dentaries. The intermaxillary band is convex anteriorly, and proceeds to the insertion of the maxillaries, where it is abruptly angularly deflected, and proceeds backward as elongated triangular extension. The band at the symphysis is slightly divided, and anteriorly separated by a small triangular extension of the labial membrane. The lower dental band is anteriorly semi-circular, and attenuated to the corners of the mouth.

There are about twelve branchiostegal rays on each side.

The dorsal fin is situated over the posterior half of the interval between the pectorals and ventrals, and has a spine and about seven branched rays.

The adipose fin is well developed, and has an elongated base resting over the posterior half of the anal; it is very obese, and inclines rapidly backward.

The anal fin commences far behind the anus, is little longer than high, and composed of about fifteen rays.

The caudal fin is oblong, subtruncated, placed on a vertical basis, and with numerous accessory, simple rays, recurrent above and beneath the caudal peduncle.

The pectorals have a broad, compressed spine, serrated or dentated on its external and internal margins, and with the prolonged fleshy integument obliquely striated.

The ventrals are rounded, and have nine rays, one simple and eight branched.

The anus is situated behind the ventrals, some distance behind their bases, and much in advance of the anal fin.

The genus *Hopladelus* is at first sight distinguished by its elongated and anteriorly-depressed body; the depressed and broad oblong head; the bands of very small villiform teeth, and the posterior extension of the upper bands; the small size of the anal, its distance behind the anus, and the recurrence of the caudal fin.

But one species is certainly known.

HOPLADELUS OLIVARIS, Gill.

Synonymy.

Silurus olivaris *Raf.* American Monthly Magazine and Critical Review, vol. iii, p. 355, Sept., 1818.
Glanis limosus *Raf.* loc. cit. vol. iii, p. 447 (Oct. 1818), and vol. iv, p. 107 (without description).
Silurus nebulosus *Raf.* Journal of the Royal Institution, vol. ix, p. 50, April, 1820.
Silurus viscosus *Raf.* loc. cit. p. 50.
Silurus limosus *Raf.* loc. cit. p. 51.
Pimelodus viscosus *Raf.* Ichthyologia Ohiensis, p. 64, July, 1820.
Pimelodus nebulosus *Raf.* Ichthyologia Ohiensis, p. 64.
Pimelodus limosus *Raf.* Ichthyologia Ohiensis, p. 66.
Pylodictis limosus *Raf.* Ichthyologia Ohiensis, p. 67.
Pimelodus punctulatus *Val.* Hist. Nat. des Poissons, vol. xv, p. 134, 1840.
Pimelodus æneus *Val.* Hist. Nat. des Poissons, vol. xv, p. 135 (abstract).
Pimelodus punctulatus *De Kay*, Zoölogy of New York Fishes, p. 187 (abstract), 1842.
Pimelodus æneus *De Kay*, Zoölogy of New York Fishes, p. 187 (abstract).
Pimelodus punctulatus *Storer*, Synopsis of Fishes of North America, p. 151; ib. in Memoirs of American Academy, vol. ii (abstract), 1846.
Pimelodus æneus *Storer*, loc. cit. (abstract).
Pimelodus limosus *Storer*, Synopsis of Fishes of North America, p. 152; ib. in Memoirs of American Academy, vol. ii (abstract).
Pimelodus limosus *Kirtland*, Boston Journal of Nat. Hist. vol. vi, p. 335, 1846.

The body is greatly elongated, and from a lateral view appears to be very slender, slowly diminishing in height toward the caudal; above, it is very much depressed anteriorly, and is rapidly attenuated toward the caudal. The greatest height in front of the dorsal fin is about a seventh of the entire length, while that of the caudal peduncle behind the anal and adipose fins equals a half of the greatest, or a fourteenth of the length. The width at the base of the pectorals is about a third greater than the heigth, and equals a fifth of the length; thence it rapidly diminishes to the caudal peduncle, which, at the base of the fin, is very thin and compressed.

The head, from the projecting lower jaw to the membranous opercular margin, forms little more than a fourth of the entire length. In profile, is elongated conical, or cuneiform, the extreme height at the pectorals being a half of the head's length. Above, the head is oblong, and very flat and depressed. The greatest width equals a fifth of the entire length of the fish, and the eyes a sixth of the same. The sides of the head are slightly convex; otherwise the width nearly equally diminishes to the snout, which is wide and truncated.

The eyes are oval and small, the longest diameter not exceeding a tenth of the length of the head. Their distance from a transverse line parallel with the front of the snout equals three diameters. The interval between each other equals half of the greatest width of the head. Seen from above, they appear to be distant about a diameter from the side of the head.

The maxillary barbels are small and slender, compressed at their base, and with the internal edge rounded. They vary in length, but do not generally much exceed half the length of the head. In one, the barbel on the left side extends to the base of the pectoral. The nasal barbels extend to about the posterior margin of the eye. The inframaxillary ones form the four angles of a transversely-elongated hexagon; the distance between the internal ones is nearly a sixth of the head's length, and that between the external ones exceeds a third of the same ($\frac{8}{26}$). The latter are about half as long as the maxillary, and about twice as long as the internal ones.

The branchiostegal bones appear to amount to twelve on each side; the two internal are wide and compressed and much larger than the others. The branchiostegal membrane is deeply, and when not extended appears to be acutely, emarginated, the emargination extending to the vertical of the posterior border of the eye. The membrane is attached to the throat to within a short distance of the bottom of the emargination. The mental fold is considerably nearer the latter than the jaw.

The dorsal fin commences at three-tenths of the length from the snout over the posterior half of the interval between the bases of the pectorals and ventrals. Its base is equal to about a twelfth of the fish's length, and equals four sevenths of the greatest height. The spinous ray is moderate, and not more than half as long as the second articulated or longest ray; it is entirely enveloped in the skin, and no serratures can be perceived; the skin in which the spine is imbedded is considerably prolonged, compressed, and obliquely rayed or striated.

The adipose fin is elongated, subrhomboidal, advancing slowly outward and backward, very thick at the base, and compressed toward the margin, which is sometimes jagged; it is situated over the last two-thirds of the anal fin, and coterminal with it.

The anal fin commences at nearly six tenths of the distance between the snout and caudal margin; its length is almost equal to a tenth of the same, and its greatest height to a ninth. The rays rapidly increase in length to the middle ones, which are longest. The rays, especially anteriorly and at the base, are enveloped in a thick fat skin.

The pectorals are situated immediately behind the descending opercular margin at less than a quarter of the length. When open, they are horizontal. The four, or longest rays, inclusive of the membranous termination of the spinous one, are nearly equal to a seventh of the entire length. The compressed spine is about half as long as the succeeding rays, and is anteriorly provided with ridges rather than teeth, and posteriorly with tubercular teeth. The membrane continued from it is coterminal with the three succeeding rays, and is striated obliquely forward and interiorly.

The ventral fins commence at the fourth tenth of the length; their bases, if continued backward, would intersect each other at right angles, but the distance by which they are separated behind is nearly equal to their base. Their margins are rounded, and the longest rays are about an eleventh of the length. They cease some distance before the anal fin.

The anus is situated between the ventrals, at a distance in advance of the anal fin equal to a twelfth of the total length; its margin is radiated by ridges. The genital papilla is small and behind.

The caudal fin is scarcely emarginate, and has a straight base; the shortest rays form fifteen hundredths of the total length, and the longest equal sixteen hundredths. Numerous simple rays, enveloped in a very fat skin, are continued on the superior and inferior faces of the peduncle.

The radial formula may be expressed as follows:

D. I. 5. $\frac{1}{1}$; A. 2. 12. $\frac{1}{1}$; C. 20. 1. 7. 8. 1. 10; P. 1. 9; V. 1. 8.

The lateral line is decurrent downward from the angle of the branchial apertures and thence continued along the middle in a straight line to the base of the caudal fin.

The skin is thick, and completely covers the skull, where it has a spongy or wrinkled appearance.

The color is brownish-fawn on the head, blotched with lighter and darker on the trunk, and on the caudal peduncle inclining to reddish. The lower barbels are whitish, like the abdomen and inferior surface of the head.

The *Hopladelus olivaris*, as will be seen by reference to the synonymy, has had the fortune of being described under a large number of names. As several bestowed by the same authors have been brought together as synonymous, the reasons for so doing will be naturally demanded.

For most of the synonyms, we are indebted to Rafinesque, a man that never touched a subject without involving it in confusion. It will therefore excite little surprise to hear that he has described the same species under six different names, and referred it to four different groups, to which he has given five generic names.

The *Silurus olivaris* described by Rafinesque in the third volume of the American Monthly Magazine and Critical Review, p. 355, has been pronounced by Rafinesque himself to be the same as his *Pimelodus nebulosus*, and is consequently the *Pimelodus limosus* of Kirtland.

It is described as follows:

"Body olivaceous, shaded with brown, 8 whole barbs, 4 beneath, 2 lateral thick brown, dorsal fin with 7 soft rays, pectoral fin 10 soft rays, anal fin 12 rays, tail rounded notched, teeth acute."

The above diagnosis, with the exception of those parts relating to the color, number of rays in the anal fin, and form of caudal fin, is applicable to most of the *Ictaluri*. The color is not inapplicable to the *Hopladelus;* the number of anal rays agrees as well with that species as with *Noturus*, and the allusion to the caudal, while it excludes *Noturus*, is referable to *Hopladelus*. The teeth of *Hopladelus* are not, however, well described by the term acute. But as the diagnosis does not suit any other species better, it is doubtless applicable to that one. The difference in the enumeration of the anal rays is probably due to the difficulty of counting them in the thick skin in which they are enveloped.

At page 447 of the same volume of the Magazine, and at page 107 of the fourth volume, the name of *Glanis limosus*, or Mud Catfish, occurs; but there is no description. The species intended is undoubtedly that afterward described as *Pylodictis limosus*, to the subsequent remarks on which we refer.

Rafinesque has best described it under the name of *Pimelodus limosus*. The description is quite creditable to him, as only one serious error occurs. It is stated that there is no lateral line; but there is certainly one present, as in all our North American species. In other respects, the description is sufficiently characteristic, and the number of rays in the anal fin is correctly said to be fifteen. No mention is, however, made of the much depressed head and body, the latter being simply described as "slender". The species is said to differ "from all others by the long lower jaw, &c.", and to attain a length of "about one foot".

The *Pimelodus viscosus* of Rafinesque, the type of his section *Leptops*, appears to be the young of *Hopladelus olivaris.* It is said to have a length of "only four inches", and its color is "brown with bluish and grayish shades covered with a clammy viscosity". The head is described as being "very flat, with a longitudinal furrow above, elongated"; the "anal has fifteen rays and the ventrals nine". Except as to the cephalic furrow, the description so far is not inconsistent with the *Hopladelus olivaris*, but the jaws are said to be "nearly equal" and "the upper hardly longer". This as well as the furrow on the head and the number of rays in the anal fin might tempt us to believe that it was the *Noturus*, but the caudal fin is said to be "unequally bilobed, the upper smaller and white, and the ventrals have nine rays". It is therefore doubtfully treated as identical with the *Hopladelus* until the researches of a naturalist shall show otherwise. It is not mentioned by Dr. Kirtland.

With some doubt, we yield to the opinion of Dr. Kirtland that the *Pimelodus nebulosus* of Rafinesque is the old of *P. limosus.* The species is said to attain a length of from two to four feet. The description is certainly not very characteristic; the species is said to differ from the former by "the conical head, membranaceous operculum, but particularly because the first ray of all the fins, except the caudal and adipose, is a kind of soft obtuse spine, concealed under the fleshy cover of the fins". On account of these differences, it is suggested that the species may belong to a "peculiar section or even sub-genus", for which the name of *Opladelus* is proposed.

No description of the operculum or spines of *Pimelodus viscosus* is given; it is probable that the notes on the two "species" were taken at different times, and that Rafinesque's attention being arrested by the characters mentioned, and not believing that they could have been overlooked by him in the *Pimelodus viscosus*, assumed that a difference existed. It is strange that the jaws should be described as equal, the head simply as "conical depressed", and the body as "conical tapering behind",* and, were not such statements made by an author proverbial for inaccuracy, we might well be excused for believing in the identity of *Pimelodus nebulosus* with a species like the present. The assertion that there are only twelve anal rays may be explained by the subsequent statement that all "the fins are very fat, thick, &c." The eyes of *Pimelodus nebulosus*, as of *P. viscosus*, are said to be round and small; those of our *Hopladelus* are elliptical.

By Dr. Kirtland, the *Pimelodus nebulosus* is considered as "merely the old" of *Pimelodus limosus.* He further remarks that "it is much larger, and proportionally shorter and broader, than the one figured (*P. limosus*). I have never seen the young unless our present species be considered as such."

The *Silurus olivaris* previously mentioned is referred by Rafinesque to his *Pimelodus nebulosus.*

Placing much confidence in Dr. Kirtland's judgment, we have followed him in regarding *Pimelodus limosus* and *P. nebulosus* as identical, but the remark regarding the difference of form excites some suspicion as to his correctness. The degree of difference is not mentioned; Dr. Kirtland would, of course, have noticed the characters mentioned by Rafinesque, if they were more than imaginary.

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* Rafinesque probably intended to be understood as referring to the "conical" outline of the head as seen from the side, and the depressed dorsal surface. The mention of the body as "conical tapering behind" also doubtless refers to the lateral view.

As no other species of *Ictaluroid*, except the *Hopladelus olivaris* and *Noturus*, with fifteen anal rays or thereabouts, has been discovered in the Ohio River by the researches of Dr. Kirtland, we must, for the present at least, regard Rafinesque's descriptions of *Pimelodus viscosus* as well as of *Pimelodus nebulosus* having been based on one of them; they agree best with the *Hopladelus.*

The *Pylodictis limosus,* named by Rafinesque from a drawing of Audubon, appears to be also founded on this species. It agrees tolerably well with the *Hopladelus,* except in the absence of the lateral line, the position of the dorsal over the abdominal fins, and the rayed second dorsal. Audubon probably omitted the lateral line, or did not represent it very distinctly; there is certainly no American Siluroid without it. The last rays of the dorsal being nearly over the bases of the ventrals, the statement, considering the author of it, sufficiently approximates to the fact. The edge of the adipose of *Hopladelus* is frequently jagged or torn, and, being so represented by Audubon, appeared to Rafinesque to be rayed. It is stated that the species "sometimes reaches the weight of twenty pounds" and "bears the names of Mud Cat, Mud Fish, Mud Sucker, and Toad Fish", names which increase the evidence in favor of the identity of Rafinesque's *Pimelodus limosus* and *Pylodictis limosus.*

The descriptions given by Rafinesque in his Monograph of the Siluri of the Ohio are all referred to the above species by their author.

In the twelfth volume of the "Histoire Naturelle des Poissons", Valenciennes describes a species as *Pimelodus punctulatus,* which appears to be also identical with the *Hopladelus.* Specimens had been sent from New Harmony and from New Orleans by Lesueur. It is said to have the form of the *Pimelodus catus,* but with a shorter anal; the lower jaw is the longer; the head very much depressed, and forming a quarter of the entire length, and a fifth longer than wide; the maxillary barbels reach the middle of the operculum; the ossified part of the pectoral spine is half the length of the fin, has its borders serrated in opposite directions, and is prolonged in a soft and articulated point. There are twelve branchiostegal rays and sixteen anal. The color is brown, dotted with black and with irregular black blotches.

The description of Valenciennes answers in every respect to the *Hopladelus,* except as to the number of ventral rays, which is said to be eight. As in every other feature it is applicable to our species, there may have been some mistake in the enumeration, or perhaps even an abnormal variety. It appears to be at least proper to consider the *Pimelodus punctulatus* for the present as identical with the *Hopladelus.*

The description of *Pimelodus æneus* of Lesueur is next abstracted, and Valenciennes remarks that, except as to form and the number of rays, it agrees with his *Pimelodus punctulatus;* he himself remarks that the difference in the number of rays might be explained by the difficulty which the thick membrane in which the rays are enveloped would present to an exact computation. As to form, he objects that the phrase applied to the *Pimelodus æneus,*—"a le corps très-long",—is not applicable to the *Pimelodus punctulatus,* of which the head enters only four times in the length. To this we would answer that the head of *Hopladelus* is certainly only a fourth of the length, but that from the little height of the body the idea derived from a side-view is that the body is very slender, and the character of "corps très-long" is, therefore, quite appropriate. Valenciennes probably did not take this fact into consideration when he observed, in his description of *Pimelodus punctulatus*, that the form was like that of the *Pimelodus catus.*

We have thus united many nominal species. In considering the species of Rafinesque as identical, we have very little hesitation. We have much with regard to those of Lesueur and Valenciennes, and it might, perhaps, have been better to provisionally retain them as distinct. The other course has, however, been preferred, as no other species at all answering to their descriptions can be found.

PLATE I.

ROCCUS CHRYSOPS GILL.

FIG. 1. General form, in which the separation of the dorsal fins, the regular curvature of the anterior dorsal region, and the nearly straight lateral line are to be noticed.

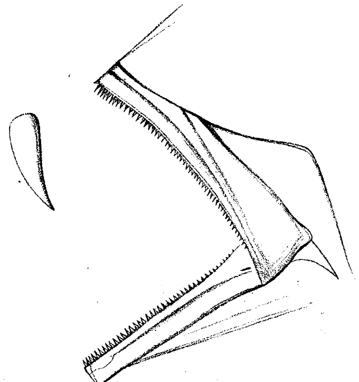
FIG. 2. A scale from the cheek, showing its sub-cycloid character.

FIGS. 3 and 4. Scales from the middle of the trunk above and below the lateral line, illustrating the ctenoid nature of the scales of the body.

FIG. 5. A scale from the lateral line.

FIG. 6. The mouth open, seen in profile.

FIG. 7. The open mouth seen from the front, to illustrate the dentition of the base of the tongue and its sides.



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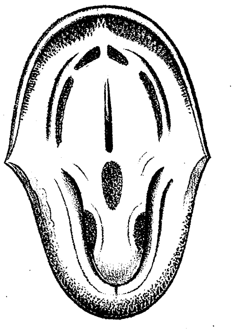

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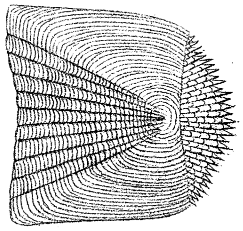

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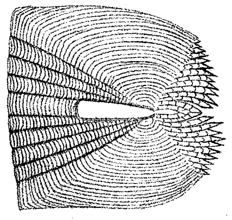

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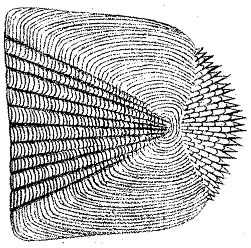

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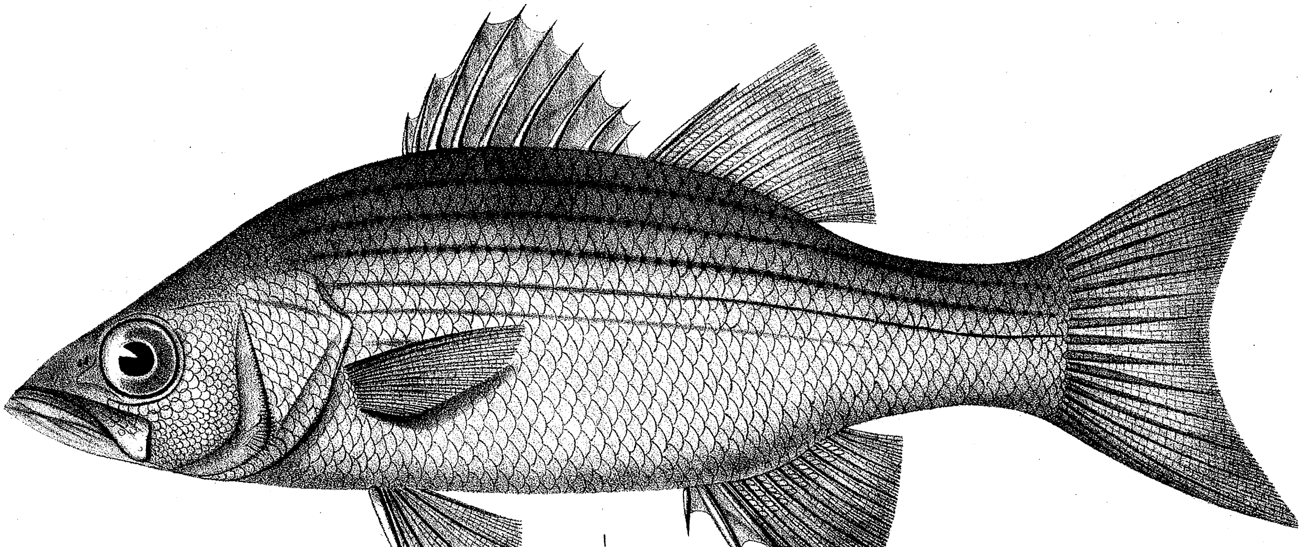

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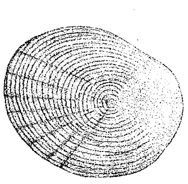

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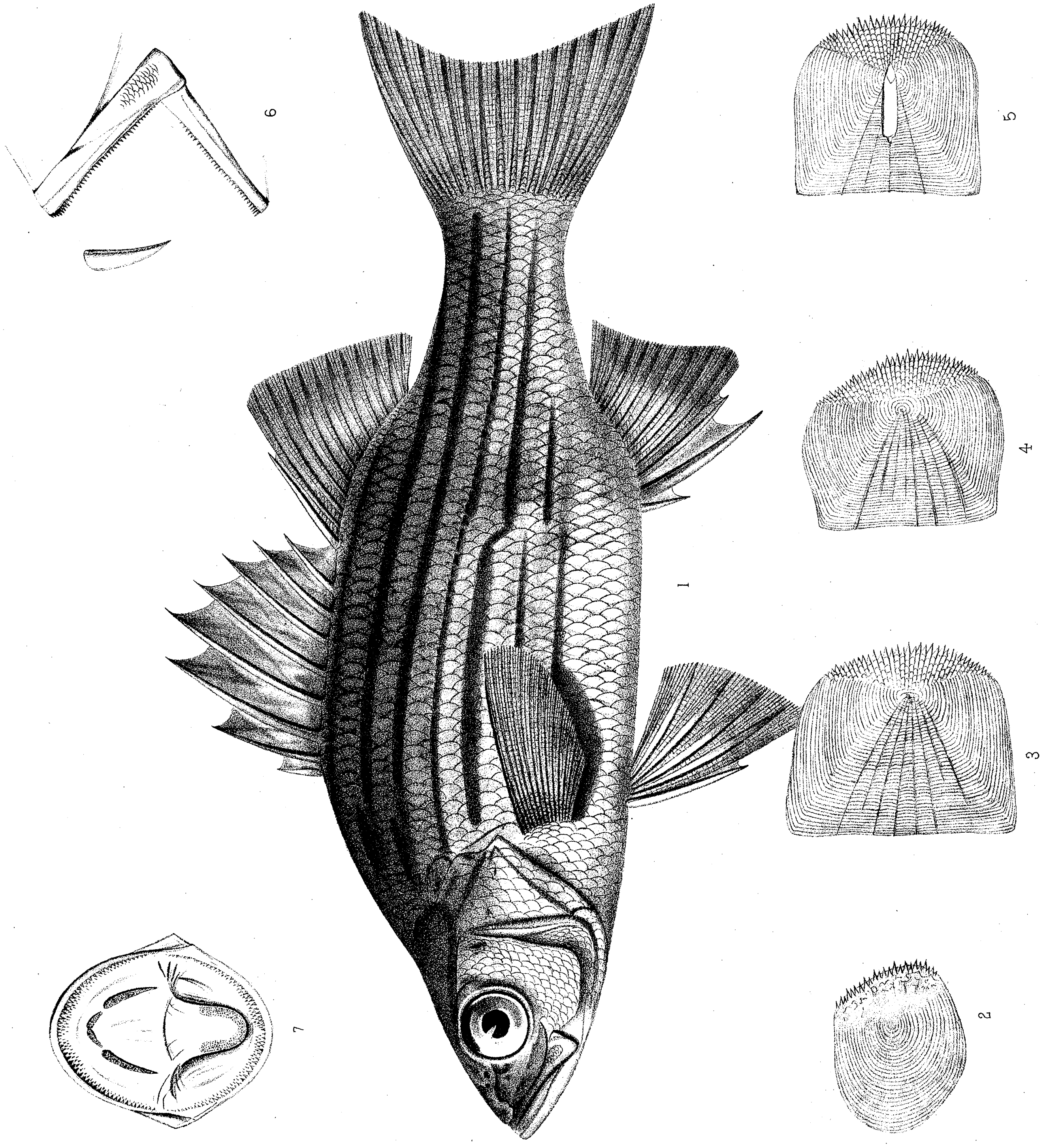
ROCCUS CHRYSOPS GILL.

PLATE II.

MORONE INTERRUPTA GILL.

FIG. 1. Side view of fish. Attention is drawn to the union of the bases of the dorsal fins and the anterior curve of the lateral line.
FIG. 2. A scale from the cheeks, exhibiting its ctenoid structure.
FIGS. 3 and 4. Scales from the middle of the trunk above and below the lateral line.
FIG. 5. A scale from the lateral line.
FIG. 6. The open mouth seen from the side.
FIG. 8. The open mouth seen from the front, illustrating the villiform band of teeth on the lateral and anterior margins of the tongue.



MORONE INTERRUPTUS GILL.

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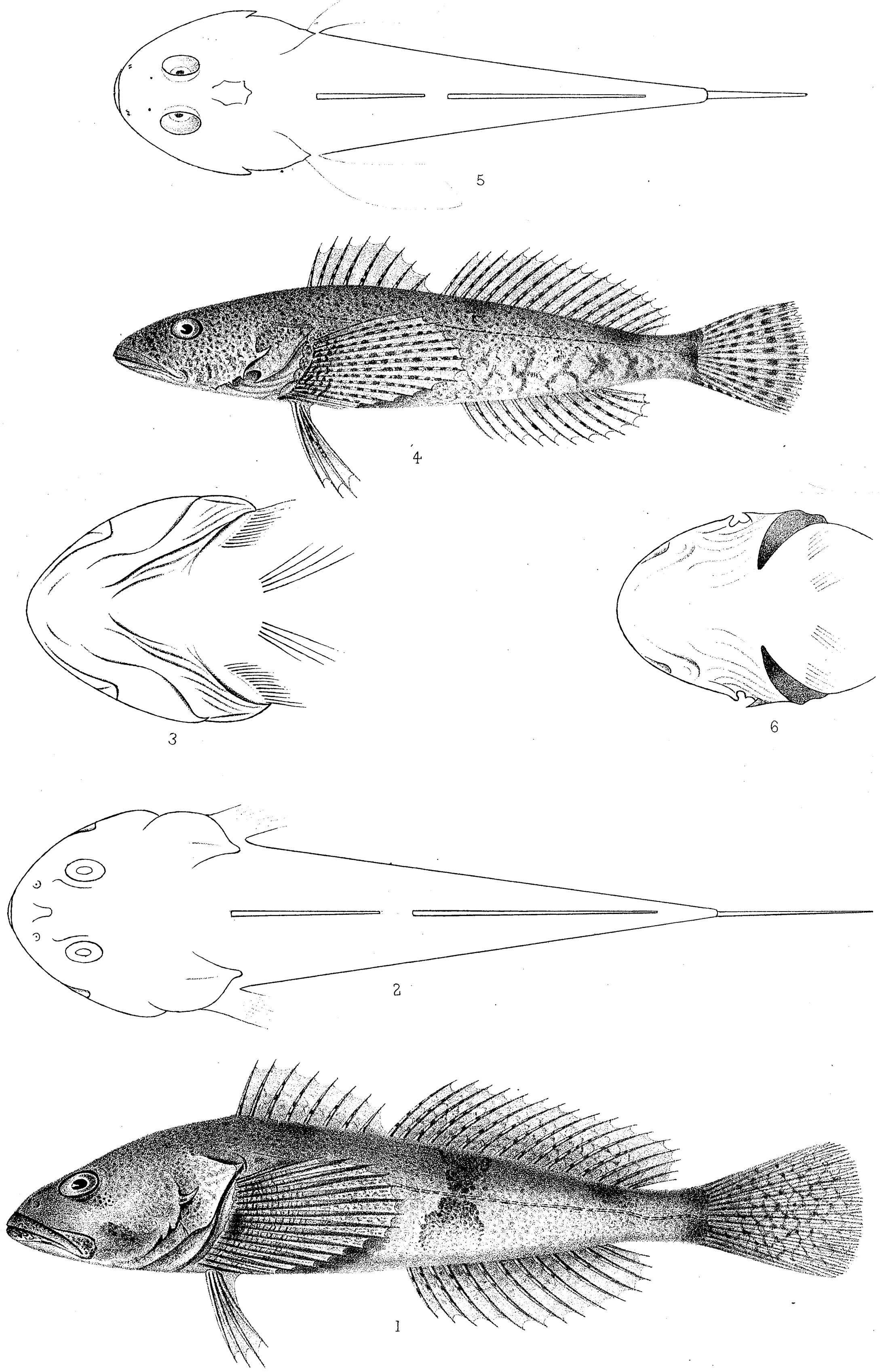
T. Sinclair & Son. lith. Phila.

PLATE III.

POTAMOCOTTUS CAROLINÆ GILL AND POTAMOCOTTUS PUNCTULATUS GILL.

The species of the subgenus *Potamocottus* differ from those of *Uranidea* only in the presence of palatine teeth. The generic characters in common with *Uranidea* are the general form of the body and fins, the depressed oval head, the presence of spines only on the preopercular, subopercular, and nasal bones, and the branchial apertures entirely separated by a moderate isthmus.

FIG. 1. *Potamocottus Carolinæ* Gill.
FIG. 2. The same seen from above.
FIG. 3. The head of same from below.
FIG. 4. *Potamocottus punctulatus* Gill.
FIG. 5. Dorsal view of same.
FIG. 6. The inferior surface of the head.



J. H. Richard. T. Sinclair & Son. lith. Phila.

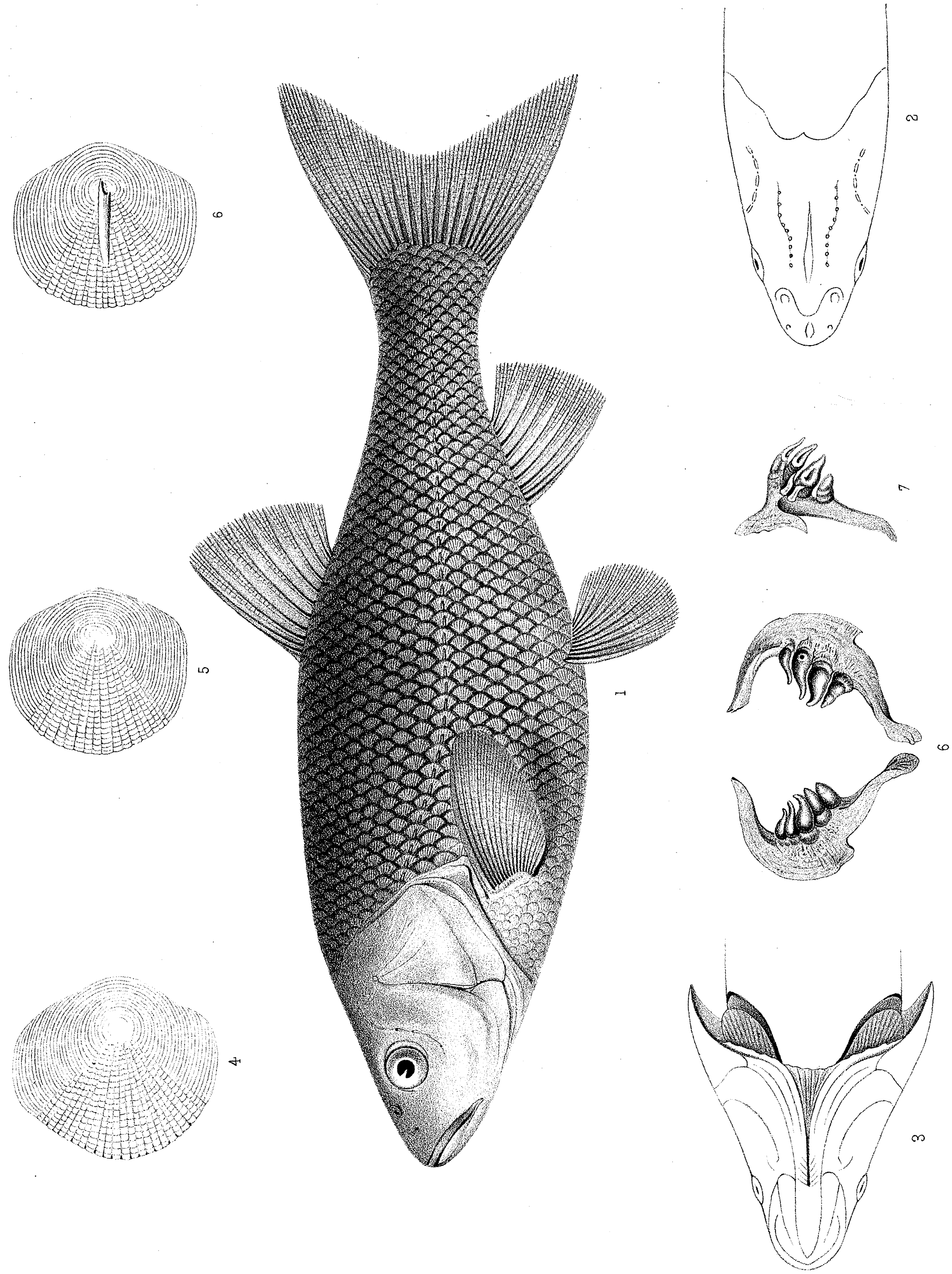
1-3. POTAMOCOTTUS CAROLINÆ GILL. 4-6. POTAMOCOTTUS PUNCTULATUS GILL.

PLATE IV.

TIGOMA SQUAMATA GILL.

FIG. 1. Side view of fish. The form of the head and body, size of the scales, and form and position of the fins are to be observed.
FIG. 2. The superior surface of the head.
FIG. 3. The inferior surface of the head.
FIG. 4. A scale from the side below the lateral line.
FIG. 5. A scale from the side above the lateral line.
FIG. 6. The pharyngeal bones.
FIG. 7. The right pharyngeal bone, representing the surfaces of the teeth.

The grinding-surface of the teeth is not a character of generic importance in the genus *Tigoma*.



TIGOMA SQUAMATA GILL.

J. H. Richard.
T. Sinclair & Son. lith. Phila.

PLATE V.

PLATYGOBIO COMMUNIS GILL.

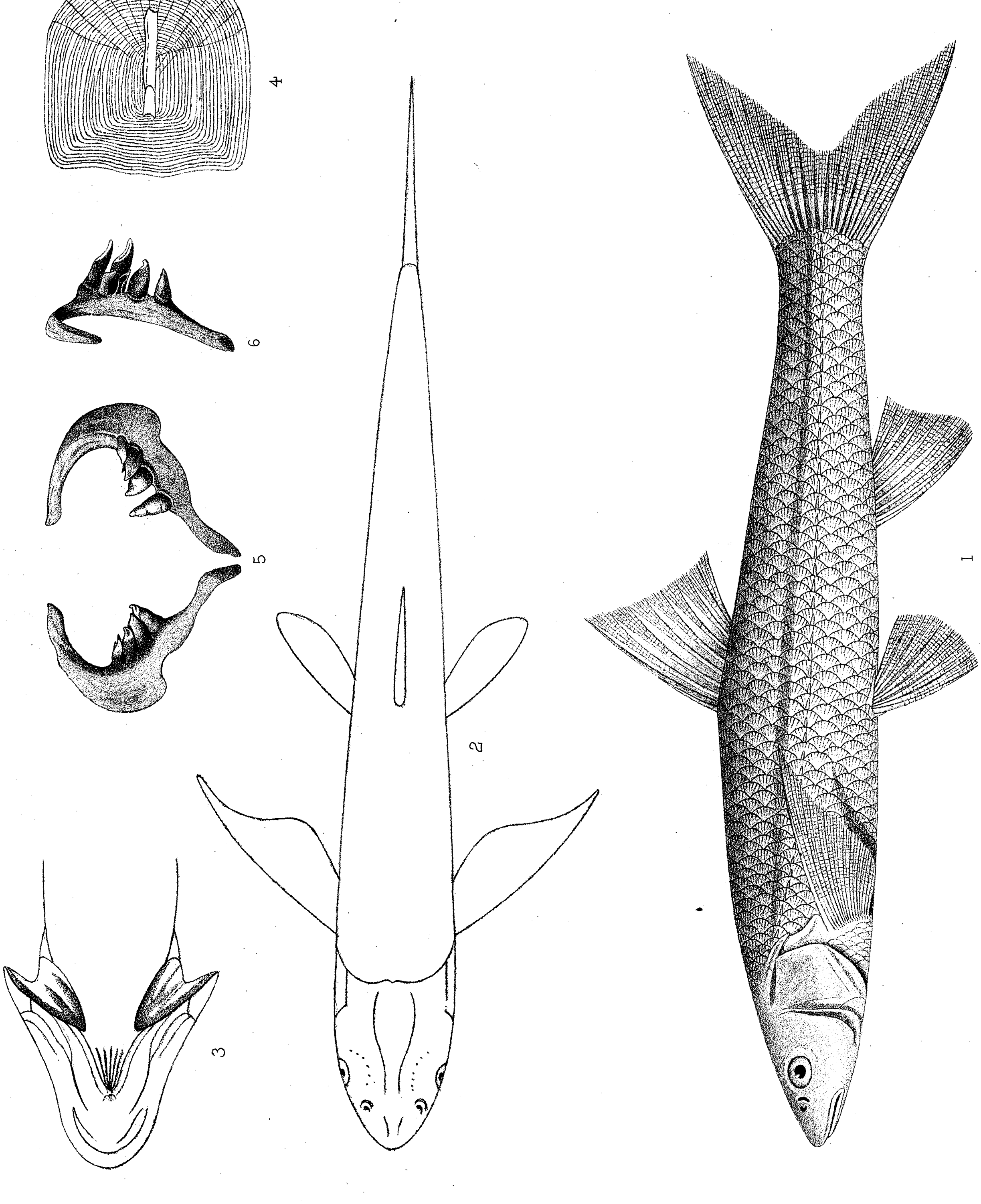
FIG. 1. Side view of fish, showing the small size of the head, the large scales, and the form and position of the fins especially the relative position of the dorsal and ventral fins. (The caudal peduncle is represented too slender.)

FIG. 2. The body as seen from above, showing the broad head. (The head does not diminish in breadth so rapidly before the eyes as represented in the figure.)

FIG. 3. The head as seen from beneath, to show the isthmus separating the lips and the width of the isthmus dividing the branchial apertures.

FIG. 4. The pharyngeal bones.

FIG. 5. The pharyngeal bone of the right side, to exhibit the grinding-surfaces of the teeth.



PLATYGOBIO COMMUNIS GILL.

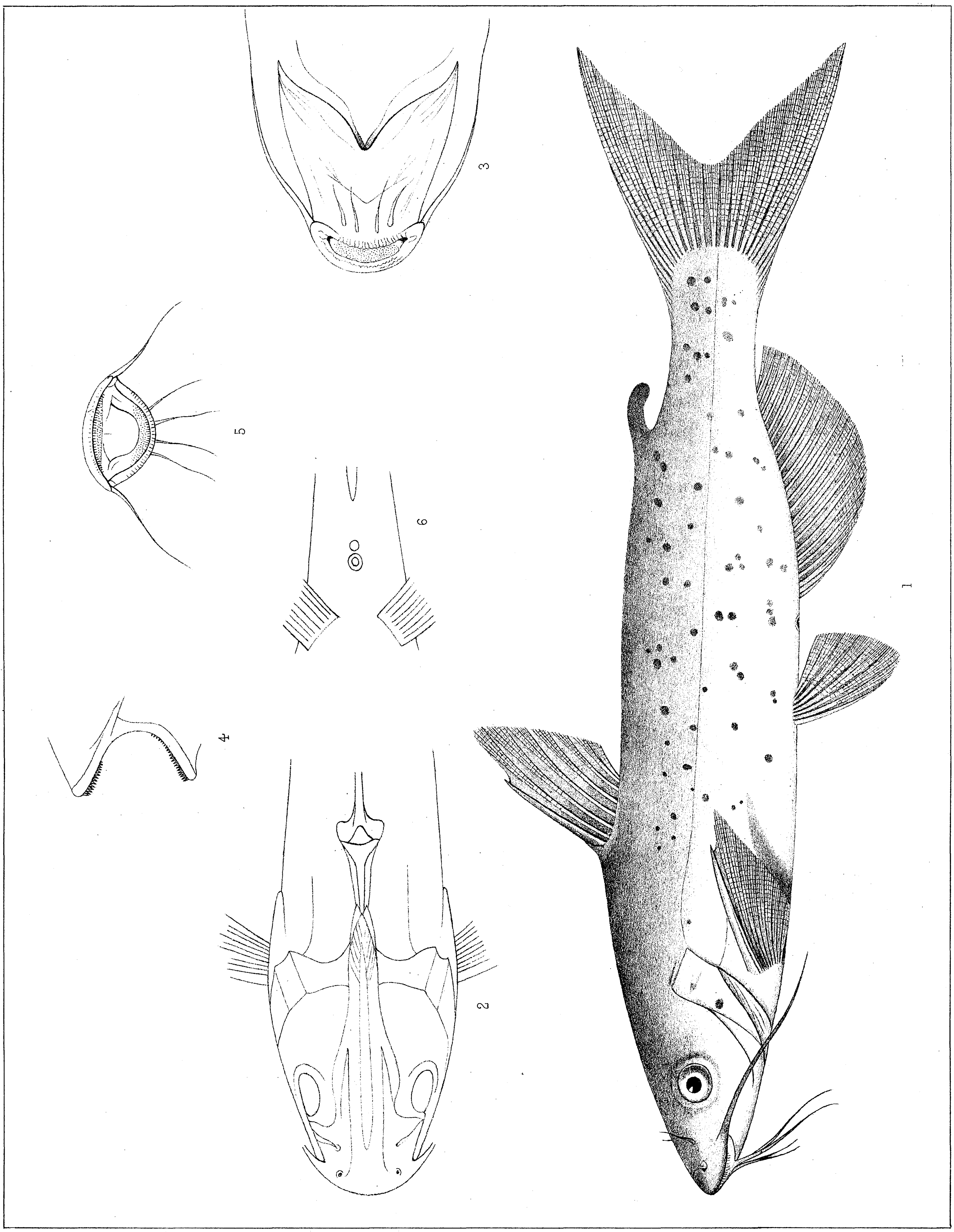
J. H. Richard.

T. Sinclair & Son. lith. Phila.

PLATE VI.

ICTALURUS SIMPSONII GILL.

FIG. 1. Side view of fish, showing the slender body, the form and position of the fins, especially the furcate caudal and the large eyes.
FIG. 2. The head from above, showing the connection of the supraoccipital with the head of the second interspinal.
FIG. 3. The head from beneath, exhibiting the emargination of the branchiostegal membrane.
FIG. 4. The open mouth from a lateral view.
FIG. 5. The open mouth from a front view, to exhibit the dentition.
FIG. 6. The inferior part of the body.



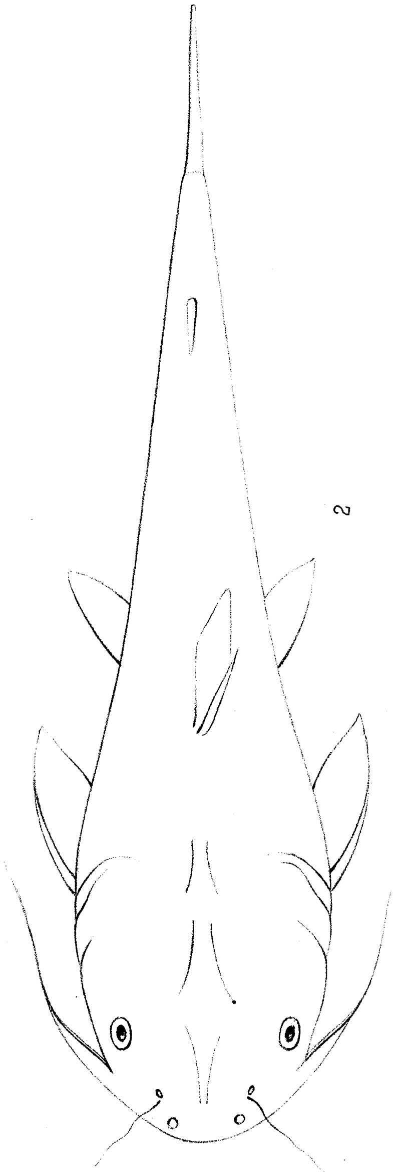
ICTOLURUS SIMPSONII GILL.

J. H. Richard.
Thos Sinclair & Son, lith, Phila.

PLATE VII.

AMIURUS OBESUS GILL.

FIG. 1. Side view of fish, illustrating the form and position of the fins, especially the caudal.
FIG. 2. The upper surface of the body, showing the shape and breadth of the head.



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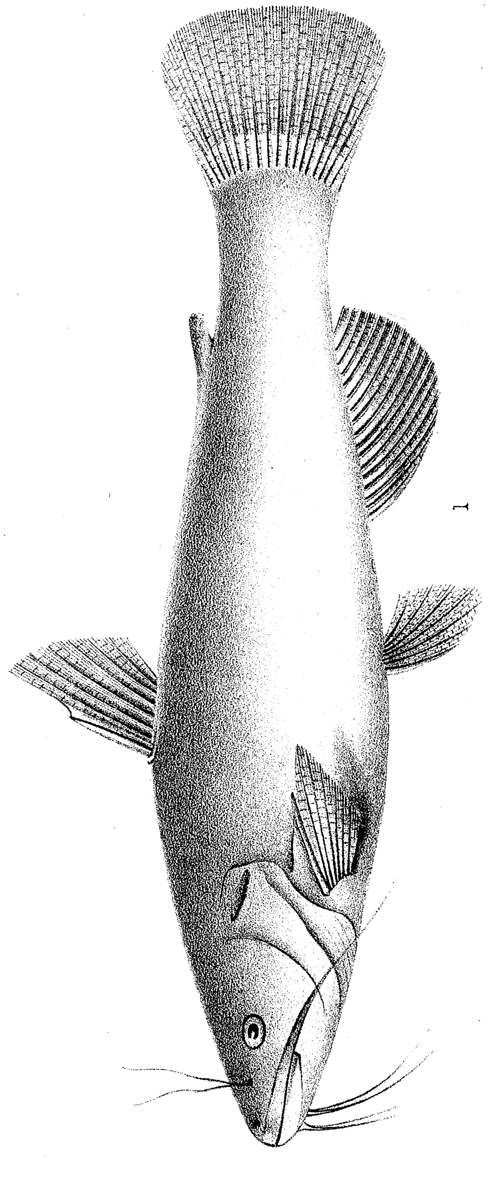

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AMIURUS OBESUS GILL.

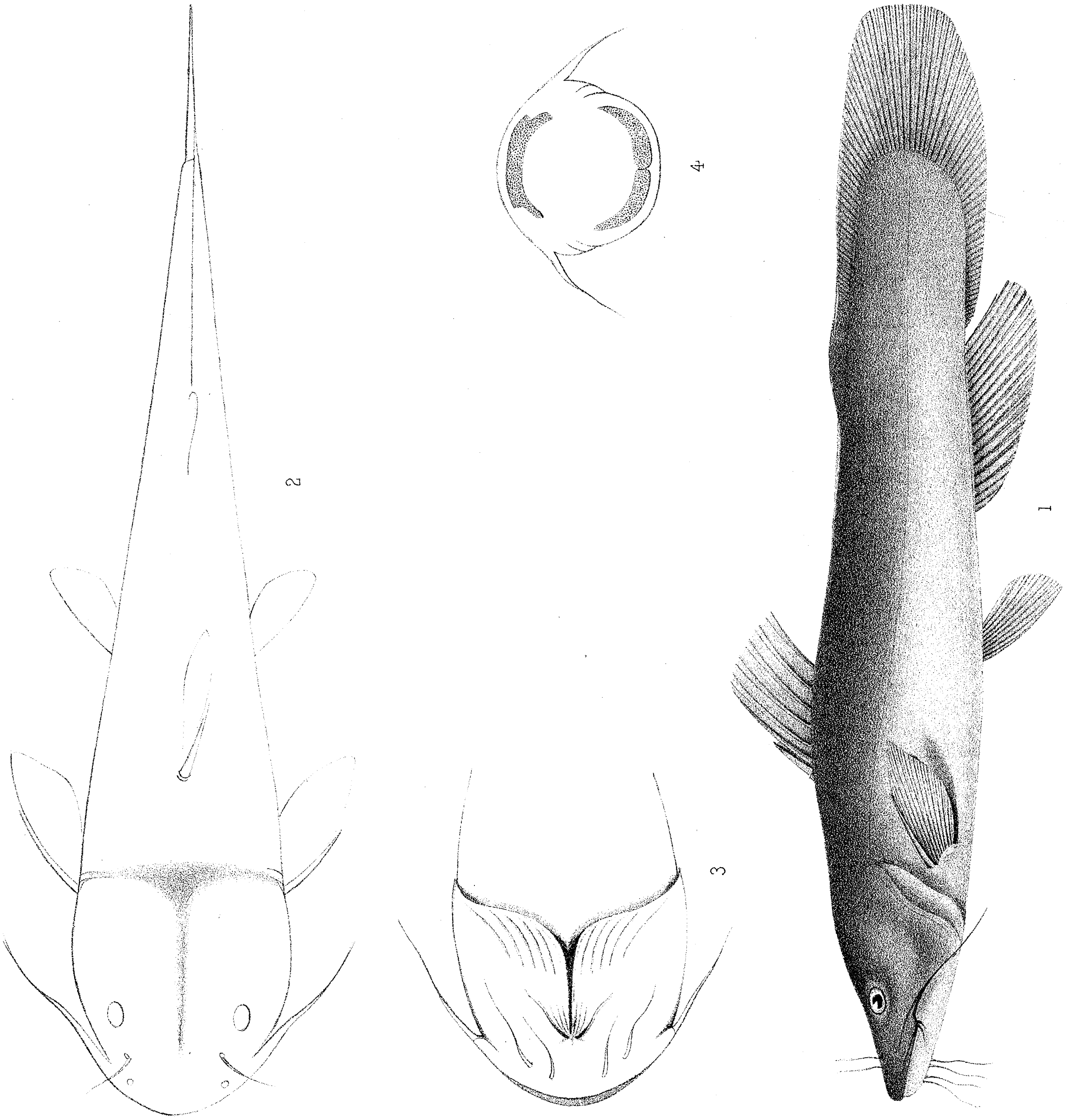
J. H. Richard.

T. Sinclair & Son. lith. Phila.

PLATE VIII.

NOTURUS OCCIDENTALIS Gill.

Fig. 1. Side view of fish, showing the peculiar form of the adipose, dorsal, and caudal fins.
Fig. 2. View of the dorsal surface, showing the broad head with its T-shaped depression.
Fig. 3. View of the inferior surface of the head.
Fig. 4. The open mouth; the teeth are robust. The lateral extension of the intermaxillary band of teeth is not a generic character.



NOTURUS OCCIDENTALIS GILL.

T. Sinclair & Son. lith. Phila.

PLATE IX.

HOPLADELUS OLIVARIS Gill.

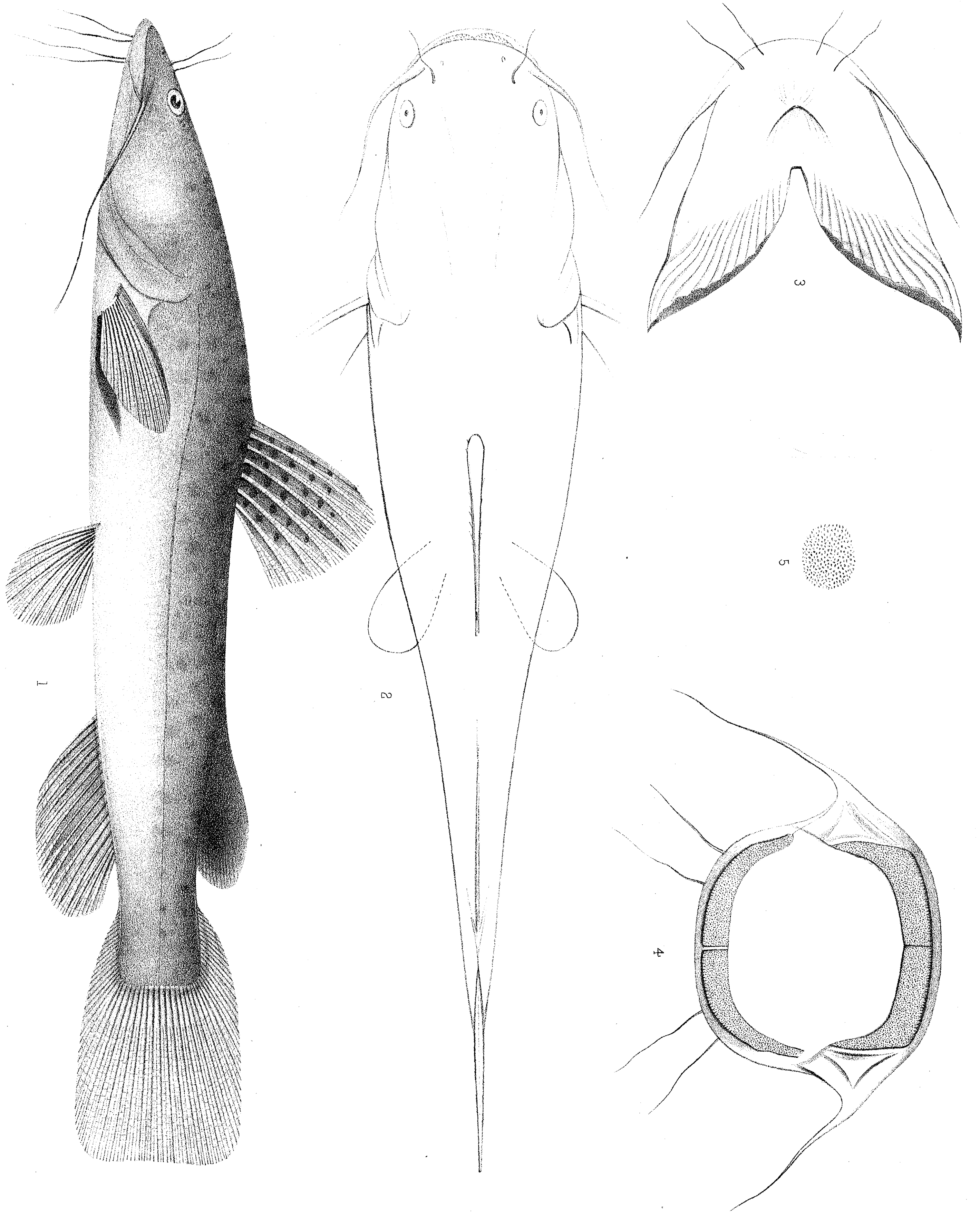
Fig. 1. Side view of fish, illustrating the peculiar form of the body and fins.

Fig. 2. Dorsal view of fish to show its width and the form of the head.

Fig. 3. The head from below, with its many (twelve) and broad branchiostegal rays. The lower jaw protrudes beyond the upper.

Fig. 4. The open mouth, with its broad bands of minute villiform teeth, and the posterior extension of the intermaxillary bands.

Fig. 5. Intended to illustrate the appearance of the skin.



T. Sinclair & Son. lith. Phila.

ILYICHTHYS LIMOSUS GILL.

APPENDIX M.

REPORT

ON THE

BOTANY OF THE EXPEDITION.

BY

Dr. GEORGE ENGELMANN.

APPENDIX M.

SAINT LOUIS, *December* 31, 1860.

DEAR SIR: Want of time has prevented me fully to elaborate the very rich botanical material brought together, under your orders, by my brother, Henry Engelmann, the geologist and meteorologist of your expedition.

I herewith inclose to you an account of a few species, which seem to have a particular, and principally a practical, interest.

I expect to continue my investigations, and hope to submit them, through you, to the scientific public at a future period.

Very respectfuly, &c.,

GEORGE ENGELMANN.

Capt. J. H. SIMPSON,
Topographical Engineers, U. S. A., Commanding Expedition.

ROSACEÆ.

CERCOCARPUS LEDIFOLIUS, *Nuttall in Torrey and Gray's Fl. N. Am.* 1, *p.* 427; *and in his continuation of Michaux's Sylva*, 2, *p.* 28, *t.* 51; *Hooker, i. c. pl. t.* 324; *Mountain-Mahogany* of the inhabitants of Utah.

This small evergreen tree is so well described by Nuttall in both works mentioned that not much remains to be added. His figure, however, is not a very faithful representation. He says that it grows much like a peach-tree, at most 15 feet high, and that the trunk is sometimes as much as a foot in diameter. On the expedition, it was found to grow rarely as a tree, but usually branching from the base, or several stems from one root; its height was from 8–15 feet, and the stems seen had the thickness of 3–6, or, at most, 10 inches. The bark is light gray, tough, smoothish, with superficial longitudinal wrinkles and short transverse scars. The wood is hard, heavy, very close-grained, light reddish-brown, with white sap; medullary rays very numerous, but extremely fine, scarcely visible with the naked eye; the wood is similar to cherry-wood, but harder and heavier. A specimen before me has a diameter of 16 lines, 14 lines of which are wood, showing 24 annual rings, so that each ring has a thickness of not much more than $\frac{1}{4}$ line. The shoots, or longer branches, have a white, smooth bark, with joints or internodes of about 1 inch in length. The leaves, however, are usually crowded at the end of lateral branchlets, a few lines to 1 or 1½ inches in length closely covered with circular scars. Leaves very thick and leathery, persistent, lanceolate, acute at both ends, entire and revolute at the margin, with a thick midrib, prominent on the lower surface, 9–14 lines long, 2½–3½ lines wide, on a petiole 1½–2 lines long, to the lower part of which adhere lanceolate, brown, scarious stipules. When young, the branchlets as well as the leaves are covered all over with short, curly hair; when older, the leaves become glabrous and glossy on the upper surface, the lower remaining hairy and assuming a rusty color. The sessile flowers are produced in June from the axils of the uppermost leaves of the preceding year's growth, either single or 2 or 3 together; short scarious bracts envelop the base of the cylindrical woolly calyx-tube, which is 3 lines long; its 5-lobed, white limb, 3–4 lines in diameter, is very woolly externally, and less so internally, and bears about 20 or 25 naked, slender filaments, with reniform anthers ½ line in diameter. Immediately after flowering, the silky-feathery style becomes elongated, and carries up with it the detached limb of the calyx; at maturity, the style becomes a twisted, feathery tail of about 2 inches in length; the inconspicuous, linear, hairy fruit itself is about 4 lines long, and remains hid in the persistent, calyx-tube; at its top and base I observe a beard of very curious, stiff, white bristles, less than a line in length, thicker in the middle, and tapering toward both extremities. The fruit seems to be somewhat persistent, as I find it in specimens collected in spring before the flowering-season. About the time of flowering, the young leaves begin to develop at the end of the branchlets, leaving the flowers between them and the leaves of the year before. I generally find 4 or 5 leaves of the same year's growth at the end of each branchlet; they probably fall off when about 15 or 18 months old.

This fine tree, discovered by Nuttall on Bear River, north of the Salt Lake, and near "Thornberg's Ravine" in the Rocky Mountains, was found by the expedition on the Lookout Mountains and other mountain-chains of the basin.

CACTACEÆ.

The geographical limits of the area of this curious American family have been considerably enlarged by this expedition, proving the presence of at least 7 species in the Utah Basin between the thirty-eighth and fortieth parallels, viz: 2 Echinocacti, 1 Cereus, and 4 Opuntiæ. Several species known before have been found in new localities, and 3 new and very distinct species have been discovered, 2 Echinocacti and 1 Opuntia.

MAMILLARIA VIVIPARA, *Haworth, Suppl. p.* 72; *Torrey & Gray, Fl. N. Am.* 2, *p.* 554; *Engelm. Synops. Cact. p.* 13; Cactus viviparus, *Nuttall, Gen.* 1, *p.* 295.

Was collected in the South Pass and on Sweetwater River. It extends from here to the mountains of Colorado and New Mexico, but its most characteristic forms are peculiar to the more elevated plains, where it assumes that cespitose, spreading appearance, from which it has received its name. The mountain form usually makes larger heads, but remains single or branches out very sparingly. Its large purple flowers, with numerous lance-linear, long acuminate, bristle-pointed petals, and its leather-brown pitted seeds, readily distinguish it from allied species.

ECHINOCACTUS SIMPSONI (*spec. nov.*[*]) simplex, subglobosus seu depressus, basi turbinatus, mamilliferus; radicibus fasciculatis; tuberculis laxis ovatis apice oblique truncatis axilla nudis, junioribus leviter compressis basi deorsum productis, vetustioribus obcompressis basi dilatatis; areolis ovatis seu ovato-lanceolatis, nascentibus albo-villosissimis mox nudatis; aculeis exterioribus sub 20 radiantibus tenuibus rigidis rectis albidis, additis supra aculeis 2–5 setaceis brevibus, interioribus 8–10 robustioribus obscuris erecto-patulis, areola florifera sub tuberculi apice arcolae aculeigerae contigua circulari; floribus in vertice dissitis minoribus; ovario abbreviato squamis sepaloideis triangulatis paucissimis (1–3) instructo; sepalis tubi brevis late infundibuliformis orbiculatis seu ovatis obtusis membranaceo-marginatis crenulatis fimbriatis, sepalis superioribus 10–12 ovatis obtusis integriusculis, petalis 12–13 oblongis apice crenulatis cuspidatis ex virescente roseis; stigmatibus 5–7 brevibus erectis, bacca parva viridi sicca umbilico latissimo truncata squamis paucis subinde aculeiferis instructa flore marcescente demum deciduo coronata irregulariter basi seu latere dehiscente; seminibus magnis obovatis obliquis minute tuberculatis, hilo magno ovato subbasilari, embryone circa albumen parcum fere circumvoluto hamato.

Var. β MINOR: tota planta, tuberculis, aculeis, floribus seminibusque minoribus.

Butte Valley in the Utah Desert, and Kobe Valley farther west; fl. in April and May, fr. in June and July. Var. β comes from the mountains of Colorado. This and the New Mexican *Echinocactus papyracanthus*,[†] the Mexican *Ech. horripilus*, Lem., and perhaps the South American *Ech. Odierii*, Lem., and *Ech. Cummingii*, Salm, and probably one or two others, form the small group of *Echinocacti*, with the appearance of *Mamillaria* (*Theloidei, tuberculis spiraliter dispositis distinctis*, Salm, Cact. Hort. Dyck 1849, cult. p. 34). They constitute the closest and most imperceptible transition to *Mamillaria* subgen. *Coryphantha*, Synops. Cact., p. 8, which bear the flowers in the axils of the nascent tubercules, the flower-bearing and the spine-bearing areolæ being connected by a woolly groove. In *M. macromeris*, Engelmann, they come from the middle of the tubercule (Cact. Mex. Boundary, t. 15, f. 4), and in the *Theloidei* they advance to the top of the tubercule close to the spines, thus assuming the position which the flowers regularly occupy in the genus *Echinocactus* (see Cact. Mex. Bound. t. 20, f. 2; t. 21; t. 25, f. 1; t. 27, f. 1; t. 28, f. 2).[‡]

The ovary is also almost naked, like that of *Mamillaria* generally, or has only a few scales, like that of *M. macromeris*. On the other hand, the dry fruit, such as is often found in *Echinocactus*, but never in *Mamillaria*, the tuberculated black seeds, and especially the large and curved embryo, and the presence of an albumen, do not permit a separation from *Echinocactus*.

This species is further interesting because it again strikingly proves that the general appearance, the *habitus*, of a cactus plant, not necessarily indicates its real affinities. Not only is it a true *Echinocactus*, notwithstanding every appearance of a *Mamillaria*, but it is, moreover, closely allied in all its essential characters to the very compact *Ech. intertextus*, Engelm., C. Bound. p. 27, t. 34, in which all traces of tubercules are lost in the straight ribs. It has the same small flowers and the same small dry fruit, containing few large seeds, of similar structure, though not entirely the same arrangement of the spines.

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[*] An extract of this description was published in the Transactions of the Saint Louis Academy of Sciences, vol. 2, p. 197 (1863).

[†] The plant I formerly described as *Mamillaria papyracantha*, Plant. Fendl., p. 49; Synops. Cact., p. 8, proves to belong to this section of *Echinocactus*. A closer examination of Mr. Fendler's original specimen shows that the floral areola joins the spiniferous one at the apex of the small nascent tubercules. Thus far Mr. Fendler's specimen, found near Santa Fé, has remained the only one ever obtained of this pretty species.

[‡] *Echinocactus brevihamatus*, Engelm., forms an exception. In this species, the flowers are situated exactly as in *Coryphantha*, at the base of the tubercle, and connected with the distinct spiniferous areola by a woolly groove, (see Cact. Mex. Bound. t. 19, fs. 2 and 3).

Full-grown specimens of our plant are 3–5 inches high and 3–4 inches in diameter, of dark-green color; tubercules loosely arranged in $\frac{8}{21}$ or $\frac{13}{34}$ order, 8 and 13 spirals being most prominent. They are 6–8 lines long, at base somewhat quadrangular, 6–7 lines wide in the vertical and 4–5 lines in the transverse diameter, becoming subcylindric upward; areolæ 3–4 lines long, a little more than half as wide. The fruit-bearing tubercules are rather stouter and shorter. Exterior spines 4–6 lines long, whitish; interior ones spreading, stouter, and a little longer (5–7 lines long), yellowish and upward deep brown or black; no truly central spine. In the very young plant, the spines, 18–20 in number and only 1–1½ lines in length, are all radiating, closely fitting with their compressed bulbous bases on a linear areola, resembling in shape and arrangement those of *Cereus cæspitosus*. Soon afterward the areola becomes wider, and 6 or 8 short, stout, brown interior spines make their appearance, divergent like the original ones. Next the ordinary arrangement, as described above, takes place.

It seems that quite early in spring the young tubercules on the vertex of the plant begin to form, exhibiting their densely woolly tops, and soon afterward, long before any spines make their appearance, the tips of the smooth brown flower-buds come out. The flowers are 8–10 lines long and of nearly the same diameter, externally greenish-purple, petals yellowish-green or verging to pale purple. The short stamens arise from the whole surface of the tube, leaving only a very small nectariferous space in its base. The fruit is about 3 or 3½ lines long and almost as wide, borne on a very large circular areola, surrounded by a woolly margin (see t. 2, f. 1). It bears toward its top 1–3 scales, sometimes with 1 or 2 small spines in their axils. The fruit usually opens by an irregular lateral slit; falling off, its base remains attached to the areola, as is the case in many (or all? or only all the dry-fruited?) *Echinocacti*, thus producing a basal opening (see t. 2, f. 5). Seeds 1½ lines long in the longest diameter, covered with minute close-set tubercles. The young seedling shows erect, pointed cotyledons, and, when a few weeks old, begins to develop its pubescent spines.

Var. *β* has been received this fall from the Colorado gold-region;* the smallest specimens were 1 inch in diameter, globose, the small tubercules in $\frac{8}{21}$ order, spines 1½–2 lines long, often curved; sometimes 1–3 darker stouter ones in the center. The larger specimens are almost of the size of those of Utah, but often depressed at top; tubercules arranged in $\frac{13}{34}$ or even $\frac{21}{54}$ order, spines only 4–5 lines long, 20–28 external and 6 or 7 internal ones.

This species has been named in honor of the gallant commander of the expedition.

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* It here grows and thrives probably at a higher elevation than any other northern Cactus, occupying *e. g.* the gravelly moraines of the Glacial period of Clear Creek Valley, between 8,000 and 9,000 feet altitude, and in the southern part of the Territory, the Sangre de Cristo Pass, 10,000 feet high (January, 1876).

Plate 1. *Echinocactus Simpsoni* as it appears in early spring; on the vertex a young growth of tubercules is visible, their tops covered with wool.

Plate 2. Details of the same.

- Fig. 1. Four tubercules from near the vertex, one shows the broad scar where the fruit has fallen off, another one is just developing its spines, exhibiting their points above the thick wool.
- Fig. 2. A detached tubercule bearing a ripe fruit.
- Figs. 3 and 4. Flowers with the upper part of the tubercule and its young spines.
- Figs. 5 and 6. The fruit magnified three times; fig. 5 showing the basal opening, fig. 6 the broad umbilicus.
- Fig. 7. A scale of this fruit, more magnified, with two axillary spines.
- Figs. 8–12. Seed: fig. 8 natural size, the others eight times magnified; fig. 9 lateral, fig. 10 dorsal, fig. 11 basal view; fig. 12 part of the surface, highly magnified.
- Fig. 13. Embryo, enveloped in the inner seed-coat, including also the albumen; magnified.
- Fig. 14. Lateral, fig. 15 frontal view of the embryo, magnified.
- Fig. 16. Seedling, a few weeks old, magnified.
- Fig. 17. Tubercules of the smaller variety from Colorado, in every state of development.

ECHINOCACTUS PUBISPINUS (*spec. nov.*)* parvulus, turbinatus, costis 13 subobliquis compressis interruptis tuberculatis; areolis orbiculatis, aculeis brevibus, rectis seu sæpe curvatis albidis apice adustis velutinis demum nudatis; radialibus superioribus 1–2 robustioribus, longioribus rectis curvatis seu hamatis, ceteris 5–8 brevioribus; aculeo centrali deficiente seu singulo robustiore longiore arrecto sursum hamato; flore?; fructu?.

Pleasant Valley, near the Salt Lake Desert, found May 9 without flower or fruit. Plant 2 inches high, 1 or 1¼ in diameter; compressed tubercules 4–6 lines distant from one another, confluent in 13 ribs, radial spines 1–4 lines long, white pubescent or almost tomentose, more so than I have observed it in any other cactus; on the lower areolæ, I find only 5–6 spines, the upper ones a little longer and stouter than the balance; farther upward, the number increases to 10, one or more of the upper ones becoming still stouter and often hooked; at last here and there a single central spine makes its appearance, 5–6 lines long, the strong hook always turned inward or upward. At first, only the dusky point of the spine is naked; with age, the whole coating seems to wear off. In another specimen, I find the spines 8–12 in number, a little longer, more slender, all radiating. The small supraspinal areola proves this plant to be an *Echinocactus;* it probably belongs, together with the next, to the section *Hamati*, Synops. Cact. p. 15.

ECHINOCACTUS WHIPPLEI, *Engelm. & Bigelw, Pacif. R. Rep. IV, Cact. p.* 28, *t.* 1, *Syn. Cact. p.* 15. Var. SPINOSIOR: globosus; costis 13 compressis interruptis; aculeis radialibus 9–11, inferioribus sæpe obscurioribus, reliquis longioribus niveis, 2 superioribus sæpe elongatis complanatis curvatis; centralibus 4, summo elongato complanato pergamentaceo flexuoso albo, 3 reliquis paullo brevioribus obscuris omnibus seu solum infimo hamatis; floribus minoribus; ovario squamis sepaloideis 5 oblongis munito; sepalis tubi linearibus margine membranaceis integris mucronulatis, petalis angustis oblongis; stigmatibus 6–7 brevibus in capitulum globosum congestis; bacca ovata parce squamata floris rudimentis persistentibus coronata.

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* This description has been published in Trans. Acad. St. Louis, vol. 2, p. 199 (1863). It is rather strange that neither this nor the above-mentioned *E. papyracanthus* has ever been found again (January, 1876).

The species was originally discovered on the Little Colorado by Dr. Bigelow, and was found afterward on the same stream by Dr. Newberry; the variety here described was met with more than 5 degrees farther north, in Desert Valley, west of Camp Floyd; remains of fruit, with the withered flowers attached, and some seeds, were found concealed between the spines from which the description has been drawn.* Globose heads 3 inches in diameter, radial spines ½–1½ inches long, central ones 1½–2 inches in length; flowers, if I may judge from the withered remains, about 1 inch long; ovary small, bearing about 5 membranaceous scales, the lower triangular, the upper oblong-linear, almost entire, and never cordate or auriculate at base, as they appear in most of the allied species; sepals of tube also narrow, linear, or oblong-linear, 2–5 or 6 lines long, ½–1 line wide, stigmas about ½ line long. Fruit apparently an oval berry, ½ inch long; seed just as it is described and figured in Whipple's Cactaceæ; the tubercules on the seed-coat are extremely minute and distant from one another, each forming a central protuberance on the otherwise flat surface of an angular cell of two or three times the diameter of the tubercule itself; embryo curved about ¾ around a rather copious albumen.

CEREUS VIRIDIFLORUS, *Engelm. in Wisliz. Mem. note* 8, *sub Echinocereo; Cact. Mex. Bound. t.* 36; *Synops. Cact. p.* 22.

This is evidently the northernmost *Cereus*, extending to the Upper Platte; it is abundant in Colorado. These northern specimens are 1–3 inches high, 13-ribbed, and show the greatest variability in the color of the radial spines; in some bunches, they are all red, in others white, in others again the colors are distributed without much regularity; sometimes the upper and lower spines are white and the lateral ones red, or a few or even a single one above and below are red and all the rest white; or the lower ones are red and the upper ones white, and all these variations sometimes occur on the same specimen. I mention this to show how little reliance can be placed on the colors or the distribution of the colors of the spines. Central spines wanting or 1 or 2 projecting horizontally, straight or curved upward, white or tipped with purple or all purple, 6–9 lines in length.

CEREUS ENGELMANNI, *Parry in Sillim. Journ. n. ser.* 14, *p.* 338; *Engelm. Cact. Bound, p.* 36, *t.* 57; *Synops. Cact. p.* 27.

Deserts west of the Salt Lake, without flower or fruit. Specimen entirely similar to the one figured in the Cactaceæ of the Boundary. The species seems to extend from the Salt Lake region southwestwardly to Arizona and the Mohave country.

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* The botanist of Dr. Hayden's Expedition of 1875, Mr. Brandegee, found it abundantly in Southwestern Colorado (January, 1876).

OPUNTIA SPHÆROCARPA, *Engelm. and Bigelow, Pac. R. Rep. IV, Cact. p.* 47, *t.* 13, *fs.* 6–7; *Syn. Cact. p.* 44. Var.? UTAHENSIS: diffusa, læte-virens, articulis orbiculato-obovatis, crassis, junioribus sæpe globoso-obovatis; areolis subapproximatis; foliis minutis subulatis divaricatis; setis brevissimis paucis stramineis; aculeis nullis seu parvulis nunc singulo longiore recto robusto albido; floribus sulphureis, ovario obovato areolis fusco-tomentosis sub-25 instructo, sepalis exterioribus transversis obcordatis cuspidatis; petalis 8 late-obovatis emarginatis; stylo vix supra stamina exserto; stigmatibus 8 brevibus erectis; bacca obovata areolis plurimis tomentosis stipata; seminibus numerosis irregulariter compressis anguste marginatis.

Pass west of Steptoe Valley, in the western mountains of the Basin, found July 19 in flower and fruit. Joints 2–3 inches long and of almost the same diameter; often over ½ inch in thickness, sometimes almost terete or rather egg-shaped; areolæ 6 or 8 lines apart; leaves very slender and acute, scarcely 1 line long, smaller than in any other of our species except *O. basilaris*, also a western form from the Lower Colorado. Bristles few, and even in old joints scarcely more than ½ line long; spines none, or on the upper areolæ a few short ones, with here and there a stouter one ¾–1 inch in length. Flowers nearly 3 inches in diameter, pale or sulphur-yellow, when fading, reddish; fruit about 1 inch long and half as wide, with a deep umbilicus, and with 20–25 areolæ, which sometimes show a few bristles or a minute spine; seeds very irregular, 2, or, in the largest diameter, sometimes 2½ lines wide.

Unwilling to increase the number of illy-defined species in this most difficult genus, I attach this plant to the only species known to me to which it possibly can be compared, *O. sphærocarpa* from New Mexico, though its fruit is not spherical, has not a shallow umbilicus, and is, at least in the specimen before me, not dry; the latter would be an insuperable distinction, if we might not suspect, what in fact is often the case, that the fruit later in the season would become dry and brittle. The leaves, which heretofore have been entirely too much neglected as a diagnostic character in this genus, and the flowers of the original *O. sphærocarpa*, are unknown thus far.

OPUNTIA TORTISPINA, *Engelm. & Bigelow, l. c. p.* 41, *t.* 8. *fs.* 2–3; *Syn. Cact. p.* 37.

Forks of the Platte; in flower in July. The specimens being very incomplete, I am not quite sure that this is the same species as that of Captain Whipple's Expedition; the joints appear to be somewhat smaller, the areolæ closer together, and the spines shorter (1–1½ inches) and rather weaker; it may possibly prove to be an extreme form of *O. Rafinesquii*, the area of which extends to the Rocky Mountains. Leaves subulate, 2 lines long; flowers 2⅓–3 inches in diameter, sulphur-yellow; ovary long (1–1½ inches), with 20–30 areolæ, with light-brown wool and short bright-brown bristles; exterior sepals obovate, lance-cuspidate; petals 6–8, broadly obovate, obtuse, crenulate; stigmas 6–8, short, erect, as long as the stamens.

OPUNTIA HYSTRICINA, *Engelm. & Bigelow, l. c. p.* 44, *t.* 15, *fs.* 5–7; *Syn. Cact. p.* 43.

A flowering specimen, collected in June between Walker and Carson Rivers, is exactly like one found by Dr. Bigelow on the Colorado Chiquito; it has slenderer and straighter spines than the one figured in Whipple's Report, and approaches somewhat to *O. erinacea*, E. & B., of the Mohave region, in which I now recognize the long-lost

O. rutila, Nutt. in Torr. & Gray Flor. 1, p. 555. Joints 5 inches long, half as wide, obovate; leaves 1½ lines long; areolæ closely set with long straw-colored bristles; lower ones with few and short white spines, upper ones with numerous grayish-red spines, 1½–2 inches in length. Flowers pale straw-colored, 2½–3 in diameter; ovary 1 inch long, with 20–30 white woolly aculeolate areolæ; exterior sepals oblanceolate, squarrose, or recurved at the elongated tip; petals obovate, obtuse, crenulate; style with 8 or 10 short erect stigmas, longer than the stamens. The squarrose tips of the sepals are particularly conspicuous on the bud.

OPUNTIA MISSOURIENSIS, *De Cand. Prod.* 3, *p.* 472; *Torr. & Gray, Fl.* 1, *p.* 555 (*in part*); Cactus ferox, *Nutt. Gen.* 1, *p.* 296.

From the deserts of Salt Lake Valley to Rush Valley; specimens without flower or fruit. Joints small (2–3 inches long), broadly obovate or circular; areolæ closely set; spines numerous, stiff, stout, angular, white, mostly deflexed.

OPUNTIA MISSOURIENSIS, var. ALBISPINA, *Engelm. & Bigelow, l. c. p.* 46; *t.* 14, *fs.* 8–10; *Syn. Cact. p.* 44.

Smith Creek, Lookout Mountains, in Western Utah; flowering in July. By their slender flexuous spines, the specimens approach to var. *trichophora*. Flowers 3–3½ inches in diameter, bright golden-yellow; ovary 1 inch long, with 20 or 25 areolæ, scarcely spiny; exterior sepals obovate, cuspidate; petals about 8, obtuse, crenulate; style shorter than the stamens; stigmas about 5, very short, erect. Some flowers have elongated and very spiny ovaries, evidently abortive.

OPUNTIA FRAGILIS, *Haworth, Suppl. p.* 82; *Torr. & Gray, Fl.* 1, *p.* 555; *Synops. Cact. p.* 45; Cactus fragilis, *Nutt. Gen.* 1, *p.* 296.

Fort Kearny to the North Platte country; in flower in June and July. This is, I believe, the first time that the flowers of this species were collected since Nuttall's discovery of it in 1813. Travelers report that the plant is very frequently seen in the sterile prairies east of the Rocky Mountains, but that it is rare to find them in flower and rarer still in fruit. Since many years I have the plant in cultivation from specimens brought down by Dr. Hayden, but have not been able to get it to flower. Nuttall only informs us that the flowers are solitary and small. In the specimen before me, they are yellow, scarcely 2 inches in diameter; ovary 8–9 lines long; the 13–15 areolæ are densely covered with thick white wool; the upper ones bear a few white spines; lower sepals broadly oval, with a short cusp; petals 5, obovate, rounded, crenulate; style longer than the stamens; stigmas 5, short, erect, cuspidate.*

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* Through the kindness of Dr. A. W. Chapman, of Apalachicola, Fla., I have received living specimens and fruit of *O. Pes Corvi*, so that I can now complete the description of this very distinct southern species.

OPUNTIA PES CORVI, *Le Conte in herb. Engelm.*; *Append. to Synops. Cact. in Proceed. Am. Acad. Arts & Sc.* 3, *p.* 346; *Chapman, Fl. South. U. S. p.* 145: diffusa, læte viridis; articulis parvis ovatis seu obovatis tumidis sæpius teretiusculis concatenatis fragilibus; pulvillis subdistantibus pulvinatis; foliis teretiusculis ovatis cuspidatis incurvis; areolis junioribus albo-tomentosis setas parcas brevissimas pallidas et plerisque aculeos 1–3 rectos rigidos sæpe basi compressos tortosve obscuros gerentibus, infimis inermibus; floribus flavis minoribus; ovario obovato pulvillos perpaucos fusco-villosos gerente; sepalis exterioribus ovato-lanceolatis, interioribus obovatis cuspidatis; petalis sub-5 obovatis spatulatis obtusis; stylo stamina æquante, stigmatibus 4–5 erectis; seminibus paucissimis anguste obtuseque marginatis in pulpa viscosa baccæ parvæ rubræ sæpe floris rudimentis coronatæ nidulantibus.

Barren sandy places along the coast of Georgia and Florida. Joints 1–3 inches long, obovate tumid, or narrower

OPUNTIA PULCHELLA (*spec. nov.*) :* parvula cæspitosa diffusa; articulis parvis obovato-clavatis; foliis minutis e basi ovata subulatis; areolis confertis, superioribus aculeos albidos rectos, singulum longiorem complanatum porrectum seu deflexum alios brevissimos radiantes gerentibus; floris purpurei ovario areolis 13–15 convexis albo villosissimis et longe setosis dense stipato; sepalis inferioribus lineari-oblongis breviter cuspidatis, superioribus spatulatis; petalis sub-8 obovatis obtusis, stylo cylindrico exserto, stigmatibus 5 linearibus suberectis; bacca sicca setosissima, seminibus crassis rhaphe lata plana notatis.

Sandy deserts on Walker River;† fl. in June.

This is one of the smallest, as it is one of the prettiest, species of this genus. It belongs to the small section of *Clavatæ* (Synops. Cact. p. 46) of the cylindric *Opuntiæ*, but is distinct from all those known to me by its small joints and purple flowers; all the others have, so far as I know, yellow flowers. Joints 1–1¼ inches long, 4–6 lines thick, very slightly tuberculated; leaves scarcely one line long; areolæ crowded, white woolly; larger central spine on the upper areolæ 4–6 lines long, flat, and somewhat rough above, convex below; smaller ones 4–6 or 10, radiating, ½–1½ lines long; flowers crowded, of a beautiful bright purplish-red or deep rose-red color, 1¼–1½ inches in diameter; ovary 4–5 lines long, beset with white capillary spines, 3–5 lines long, 15–20 on each areola; style not ventricose, as is usual in the genus, but cylindric; stigmas slender, pale yellow; berry clavate, at last dry, about 1 inch long, well marked by the conspicuous white-woolly areolæ and their numerous purplish-brown, flexible, hair-like bristles, 4–6 or 7 lines long. These bristles are entirely destitute of the minute barbs which otherwise invariably characterize spines and bristles of *Opuntiæ*. The thick round seeds, 2 lines in diameter, are well distinguished by a broad rhaphe, much wider than I have seen it in any other clavate *Opuntia*.

Plate 3, Fig. 1. Part of a plant of *Opuntia pulchella*, showing a flower-bud and two flowers, natural size.
Figs. 2–4. Bunches of spines, 4 times the natural size.
Fig. 5. Section of a larger spine, more magnified.
Fig. 6. A leaf from an ovary with the axillary woolly and bristly areola, 4 times natural size.
Fig. 7. A fruit.
Figs. 8–9. Seed, 4 times magnified; fig. 9 showing the broad rhaphe.

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and cylindric, fresh or dark green, usually growing one on top of the other, forming chains of 1 or 2 feet long, at last prostrate; joints fragile, separating as readily as in *O. fragilis*; tumid pulvilli 4-6 or even 8 lines apart; leaves 2½–3½ or 4 lines long, incurved; spines 1–1½ inches long, very straight, when in threes divergent like the "crowsfoot" used against cavalry, whence the name given by the military gentlemen who discovered this species. Flowers 1½–1¾ inches in diameter; sepals and petals less numerous and narrower than in any allied species; ovary about ½ inch long, with only 2 or 3 areolæ on the surface and 3–5 on the upper margin. Fruit obovate, 6–7 lines long, rose-purple, with a shallow umbilicus, oftened crowned with the blackened remains of the flower; areolæ almost obliterated; red pulp very glutinous, including 1–3 or at most 5 seeds, which are regularly shaped, lenticular, with a narrow but thick and very obtuse rim. By its pulpy fruit, this species is widely removed from *O. fragilis*, to which its tumid and fragile joints seem to ally it, nor can it be confounded with any other species, though allied to *O. vulgaris* and *O. Rafinesquii*.

* An account of this species was given in the Transactions of the St. Louis Acad. 2, p. 201 (1863).

† This pretty species was afterward collected, 1867, "among the sage brushes" of Nevada, by Mr. William Gabb, and in the following year by Mr. S. Watson "frequent in the valleys of Western Nevada from the Trinity Mountains to Monitor Valley, 4–5,000 feet alt."

COMPOSITÆ.

The name of "*Wild Sage*", now so familiar to every traveller in our western mountain-deserts, was first used by Lewis and Clarke, in the narrative of their adventurous expedition, to designate several species of *Artemisia* or *Wormwood*, distantly resembling the true garden sage, *Salvia officinalis*, by their gray foliage and aromatic odor. It seems that now this name has, by common use, been restricted to the larger shrubby species, which give a peculiar character to the arid plateaus of Western North America, and which are of the highest importance to the traveller as "furnishing the sole article of fuel or shelter which they meet in wandering over these woodless deserts", as already Nuttall informs us in his genera of North American Plants, 2, p. 142. He states that the "Wild Sage" is his *Artemisia Columbiensis*, which name was by him improperly substituted for the prior name of *A. cana*, described by Pursh from the original specimens of Lewis and Clarke. Torrey and Gray, in their Flora of N. America, 2, p. 418, doubt whether this really is the "Wild Sage" of those travelers, and come to the conclusion that that name was indiscriminately applied to several shrubby species; they further state that the plant given by Governor Lewis to Pursh as "the Sage" is the herbaceous *A. Ludoviciana* found on the homeward voyage on the Missouri River.

I have now the means, through information obtained from Mr. H. Engelmann and from Dr. F. V. Hayden, to throw a little more light on this question, which is not without importance for botanical geography. The two species here in question are—

ARTEMISIA CANA, *Pursh, Fl. Am. sept.* 2, *p.* 521; *Torrey and Gray, Fl. N. Am.* 2, *p.* 418.—Shrubby, with woody stem 2–4 inches in diameter, 2–4 feet (on the Yellowstone, Dr. Hayden) or 2–6 feet high (on the Laramie Plains, H. Engelmann). Stem covered with a light-gray bark, which is separated into many layers of loose shreds connected by smaller transverse fibers, and is readily torn off. Wood light, porous, pale-colored, with very many darker brown medullary rays, easily separating along the division of the annual rings. These rings, or layers, are from ½–1 line in thickness, as stems of 1½–2 inches diameter show about a dozen rings, and are consequently as many years old. The stems are rarely cylindrical, but mostly compressed, knotty, and variously twisted, and often stunted; they are sometimes divided from the base, but oftener bear short and thick branches higher up. The annual branchlets are crowded along the older branches, 8–12 inches long, densely coated with a soft, white pubescence, and crowded with silvery-gray leaves, and bear toward their upper part and on the numerous short and erect lateral branchlets a profusion of small flower-heads, forming a spiked or contracted panicle, interspersed with short leaves. The leaves are flat, linear-lanceolate, entire or (the lower ones) rarely lobed, 1–2 or 2½ lines wide and 1½–2 inches long, the upper ones becoming smaller. The flower-heads are mostly sessile, or nearly so, hemispherical, about 2 lines long and wide; outer scales of involucrum shorter, foliaceous, and canescent (sometimes the lowest ones larger than the flowers, and pointed); inner scales nearly as long as flowers, brownish, scarious, obtuse, cottony-fimbriate on the margins. The flowers are all perfect, usually 5, in some specimens as many as 8 in number, 1½ lines long; ovary glandular, and, when bruised, with the odor of wormwood.

This is the "Wild Sage" of the Upper Missouri (above the mouth of the Yellowstone) and the Yellowstone River, and of the Laramie Plains, but it does not seem to occur west of the Rocky Mountains, as Torrey and Gray (*l. c.*) already state, and Nuttall (*l. c.*) must have confounded it with other species, when he contends that it is "still more abundant on the barren plains of the Columbia River", and that it grows 6 to 8 or 12 feet high.

ARTEMISIA TRIDENTATA, *Nuttall in Trans. Amer. Phil. Soc.* (*n. ser.*) 7, *p.* 398; *Torrey and Gray*, *Fl.* 2, *p.* 418.—Trunk, bark, and wood very similar to that of the last species, but trunk often larger, and usually even more twisted and knotty, with very numerous short and stunted branches, which are repeatedly divided into a great many smaller branchlets; ultimate annual branchlets fascicled, erect, only 3–6 inches long, canescent or silvery, very leafy at base, rather naked upward, bearing strict, rather compact, paniculate spikes, composed of sessile or usually pedunculate spikelets or glomerules of 3 to 6 or 8 sessile heads. Leaves silvery-white on both surfaces, crowded at the base of the branches, and often fascicled on short or stunted sterile branches, narrowly wedge-shaped, 1½–2 lines wide at the obtuse tridentate or trilobed end, narrowed down into a more or less distinct petiole; usually 3–6, rarely 8, lines long. Inflorescence interspersed with short and narrow, undivided, cuneate or spatulate obtuse leaves. Heads of flowers narrow, obovoid, nearly 1½ lines long, not much more than half as wide, with short and obtuse, canescent, exterior scales, and longer, scarious, interior scales, ciliate on the sides. Flowers in some specimens 3, in others often 4–5 in each head, all perfect, scarcely more than 1 line long; ovary quite glandular and with the odor of turpentine.

This is the "Wild Sage" of Utah, and, perhaps, of the whole region west of the Rocky Mountains, where it seems to supplant the more eastern *A. cana*. Nuttall, who first described it, calls it a shrub about a foot high, and as such it appears in the mountains of Colorado; but in Utah it is the largest and most abundant species, usually 2–4 feet high, rarely attaining a height of 6 feet, and then not straight, and with trunks of 3–6 inches diameter; sometimes the smallest bushes have trunks fully as thick as the tallest ones, short and chunky. East of the mountains, in the range of *A. cana*, it ever remains an inconspicuous shrub, lost among the more common species. Near Camp Floyd, specimens were collected bearing white tomentose excrescences of the size of a pea, or larger, undoubtedly galls caused by the sting of insects; the same have been observed on this species in Colorado.

The other species of *Artemisia* collected by the expedition were *A. Canadensis*, Michx., at Bridger's Pass; *A. Ludoviciana*, Nutt., at Sweetwater, Bridger's Pass, Round Prairie, etc.; *A. dracunculoides*, Pursh, on the Sweetwater; and *A. frigida*, Willd., on the Upper Sweetwater River.

CHENOPODIACEÆ.

SARCOBATUS VERMICULATUS, *Torrey in Emory's Report* (1848), *p.* 149. Batis (?) vermiculata, *Hooker*, *Flor. Bor.-Am.* 2, *p.* 128 (1840); Sarcobatus Maximiliani, *Nees in Pr. Maximil. Trav. Engl. ed. p.* 518 (*ex Torrey*), *Seubert in Bot. Zeitung*, 1844, *p.* 753, *cum tab.*, *Lindley in Hooker*, *Lond. Journ. Bot. IV*, *p.* 1 (1845); Fremontia vermicularis, *Torrey in Frémont's First Report*, 1843, *Rept.* 1845, *p.* 95, *and Frémont's Second Report*, 1845, *p.* 317, *tab.* 3; Sarcacanthus, *Nuttall in Pl. Gambel*, *p.* 184; Sarcobatus vermicularis, *Torrey in Sitgr. Rep. p.* 169, *in Stansb. Rep. p.* 394, *in Bot. Whipple*, *p.* 130;* *Pulpy Thorn* or *Pulpy-leaved Thorn* of Lewis and Clarke; *Greasewood* of the present travelers and settlers.

This curious and important plant is found on the arid saline plains, principally on clayey soil, which in the wet season is moist, and on the border of salt-lakes, often covering large patches, from below Fort Pierre on the Missouri (*Dr. Hayden*) to the Upper Platte River (*Frémont*, *H. Engelmann*), and Upper Canadian (*Dr. James*) east of the Rocky Mountains to the plains of the Columbia (*Lewis and Clarke*, *Douglas*, *Frémont*), Utah (*Frémont*, *Stansbury*) through the Basin to Carson Valley (*H. Engelmann*) and down to the Gila River (*Emory*). Though discovered and noticed by Lewis and Clarke (1804) and collected by Dr. James (1819), this shrub was first described, 1840, by Hooker, in his North American Flora, from Oregon specimens, and was doubtfully referred by him to *Batis*. A few years later, it was again described by Nees in his account of the plants collected by the Prince of Neu Wied as a new genus under the name of *Sarcobatus*, and very soon afterward, and without a knowledge of the publication by Nees, again by Torrey under that of *Fremontia*. It is a great pity that this last name had to give way to priority, though at present a much handsomer and showy Californian shrub bears Frémont's name, the wide-spread *Greasewood* of the western mountains and deserts would more fitly have commemorated the bold and hardy pioneer of explorers to the millions, who now do or in time to come will know and value this plant.

The *Greasewood* forms a scraggy, stunted shrub, 2 or 3 to as much as 6 or 8 feet high; in Utah, it is commonly 3–4 feet high. The stems are scarcely ever more than 1 or 2 and rarely 3 inches thick, knotty, flattened, twisted, and often with irregular ridges and holes (the scars of decayed branches); sometimes, however, many straight shoots issue from a single base, $\frac{1}{4}$–$\frac{1}{2}$ inch thick, so straight as to be used for arrows. They are covered with a compact, smoothish or slightly roughened, light-gray bark. The wood is very hard and compact, of light-yellow, in the core light-brownish, color, with very thin annual layers, in younger plants about $\frac{1}{3}$, in older ones $\frac{1}{4}$ of a line or less thick. The oldest stems seen showed 20–25 rather indistinct rings, and were consequently so many years old. The numerous smaller branches have a smooth, shining, white bark, and are beset with white spines at right angles; these spines are indurated branches of two kinds. The sharper and shorter ones are real spines, scarcely ever more than $\frac{1}{2}$–1 inch long; they bear leaves only, or, in the axils of these, female flowers, and are terminated by a sharp point and never by a staminate spike. The other spines are branchlets which did bear such a terminal spike, which, after flowering, has fallen away; they are 1–2 inches long, sometimes even longer, when they are apt to bear also lateral spines. The flower-bearing branches are very often secondary axillary productions closely under the sterile primary branch, which constitutes the spine, so that the spines often appear as axillary to the flower-bearing branches. The leaves are thick and pulpy, linear, or often narrowed toward the base, flattened or even slightly channeled on the upper surface, and keeled on the lower one, at least toward the base, leaving a triangular scar after falling off. They are ½–1 inch, rarely as much as 1½ inches long, and ½ line, or sometimes, in the upper half, even 1 line, wide; in young and vigorous shoots, I have seen the leaves flatter, shorter, and broader, almost lanceolate. Their surface usually is perfectly glabrous; in specimens from Carson Lake, however, I find the younger leaves covered with a rough and sometimes branched pubescence. The leaves are sometimes on the lower part of the branches opposite, but commonly alternating in ⅖ order. The staminate and pistillate flowers are both very imperfect, but very different in their arrangement and structure; they usually occur on the same plant, though some plants seem to bear scarcely any but staminate, others only pistillate, flowers. The staminate flowers are crowded into a deciduous spike or ament, terminating the branches. This spike is, before the flowers open, 3–5 lines long and 1½ lines thick, and very compact, exhibiting only the rhombic surfaces of the scales; afterward it elongates to the length of 5–9 lines, showing the deciduous anthers under and between the separated scales. The spike consists of 25–35 peltate angular scales, pointed at the upper end, which cover 3–5 broadly oval anthers, sessile on the rhachis, ½ line long, 2–celled, opening laterally. The fertile flowers are usually solitary in the axils of the leaves and sessile; in some specimens, I find a secondary flower just below the primary one, and sometimes even below a branch, springing from the same axil; sometimes they are aggregated on abbreviated branchlets, forming irregular clusters. The flower consists of a tubular calyx with an inconspicuous rim, investing the lower half of the ovary, which is terminated by two unequal subulate stigmas, lateral in regard to the stem. In the fruit, this rim is enlarged to a broad, circular, spreading wing, 3–5 lines in diameter, green or sometimes red, which surrounds the upper third of the fruit. The flattened vertical seed, inclosed in the membranaceous utriculus, is about 1 line in diameter, and contains a spiral embryo without an albumen, as already demonstrated and figured by Professor Torrey in Frémont's Report.

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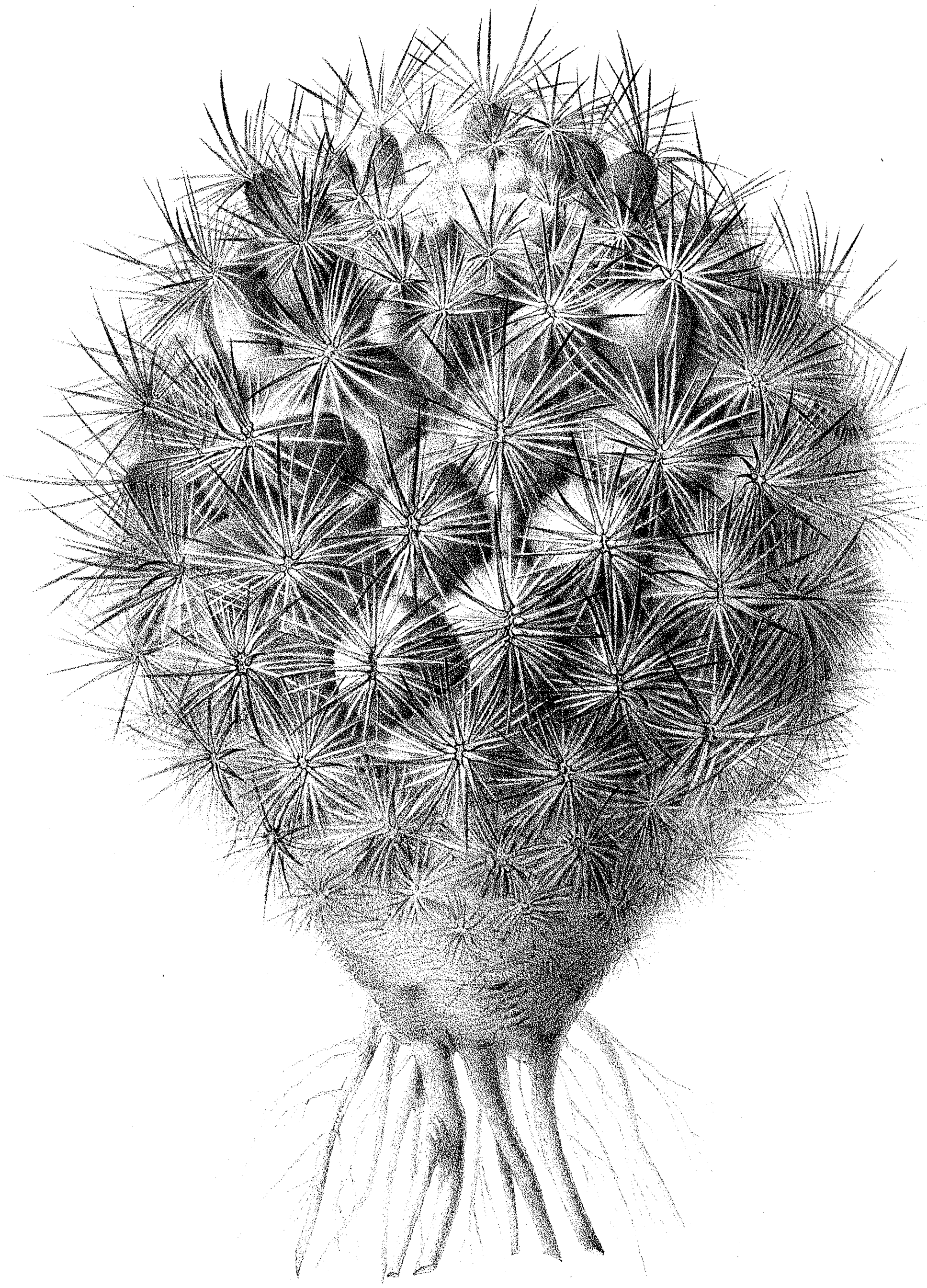
* Compare S. Watson's Revision of the American Chenopodiaceæ in Proc. Am. Ac. Arts Sc. vol. 9, p. 82 (1875).

The Greasewood is found in flower from June to August.

The form from Carson Lake seems to be distinguished not only by the pubescence of the younger parts of the plant, but also by its more squarrose growth, its subdiœcious flowers, and its aggregated fertile flowers and fruits; but the Greasewood of other localities is also often subdiœcious, so that when first described, it was considered a truly diœcious plant.

George Engelmann.



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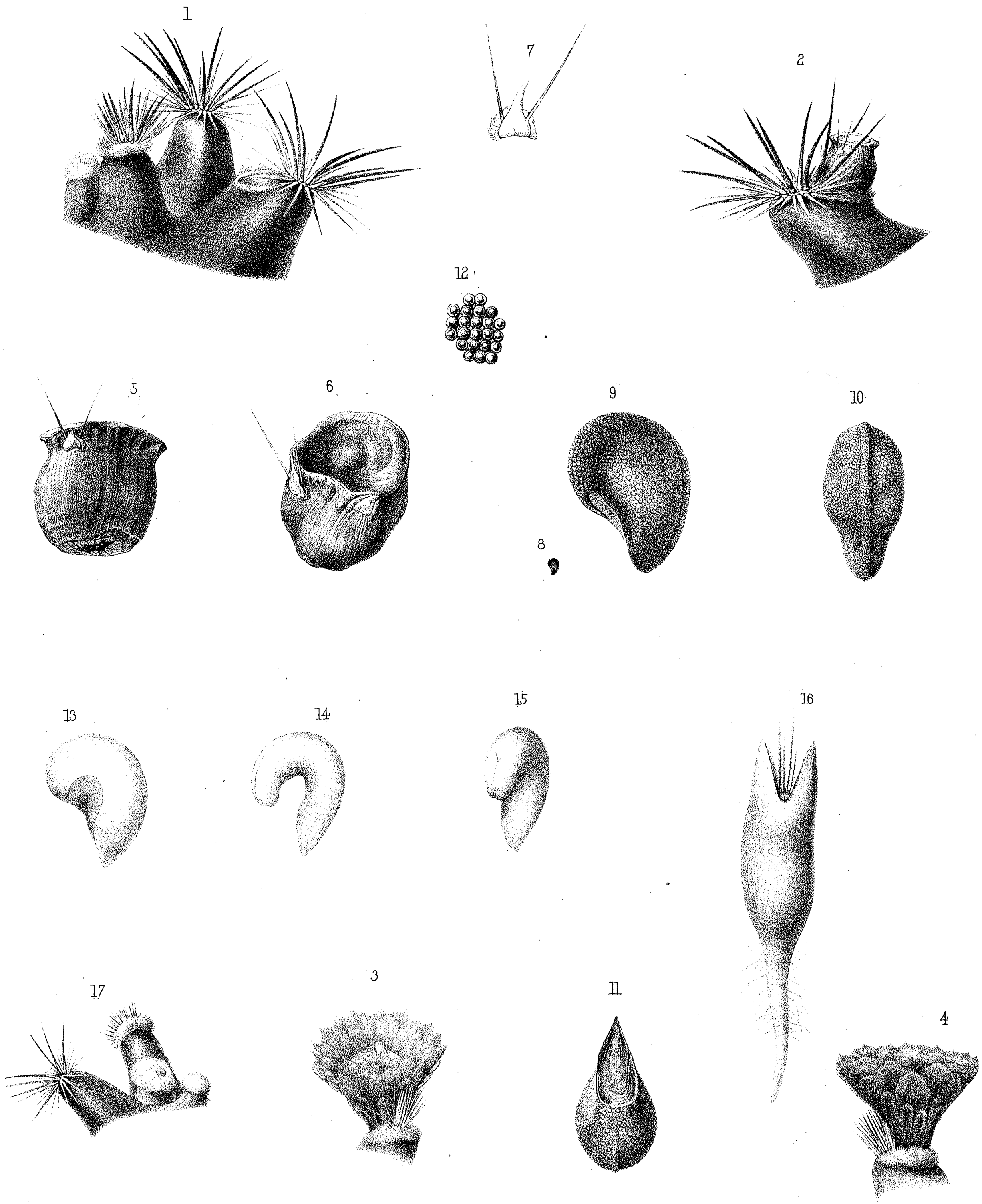
T. Sinclair & Son. lith. Phila.

ECHINOCACTUS SIMPSONI ENGELM.



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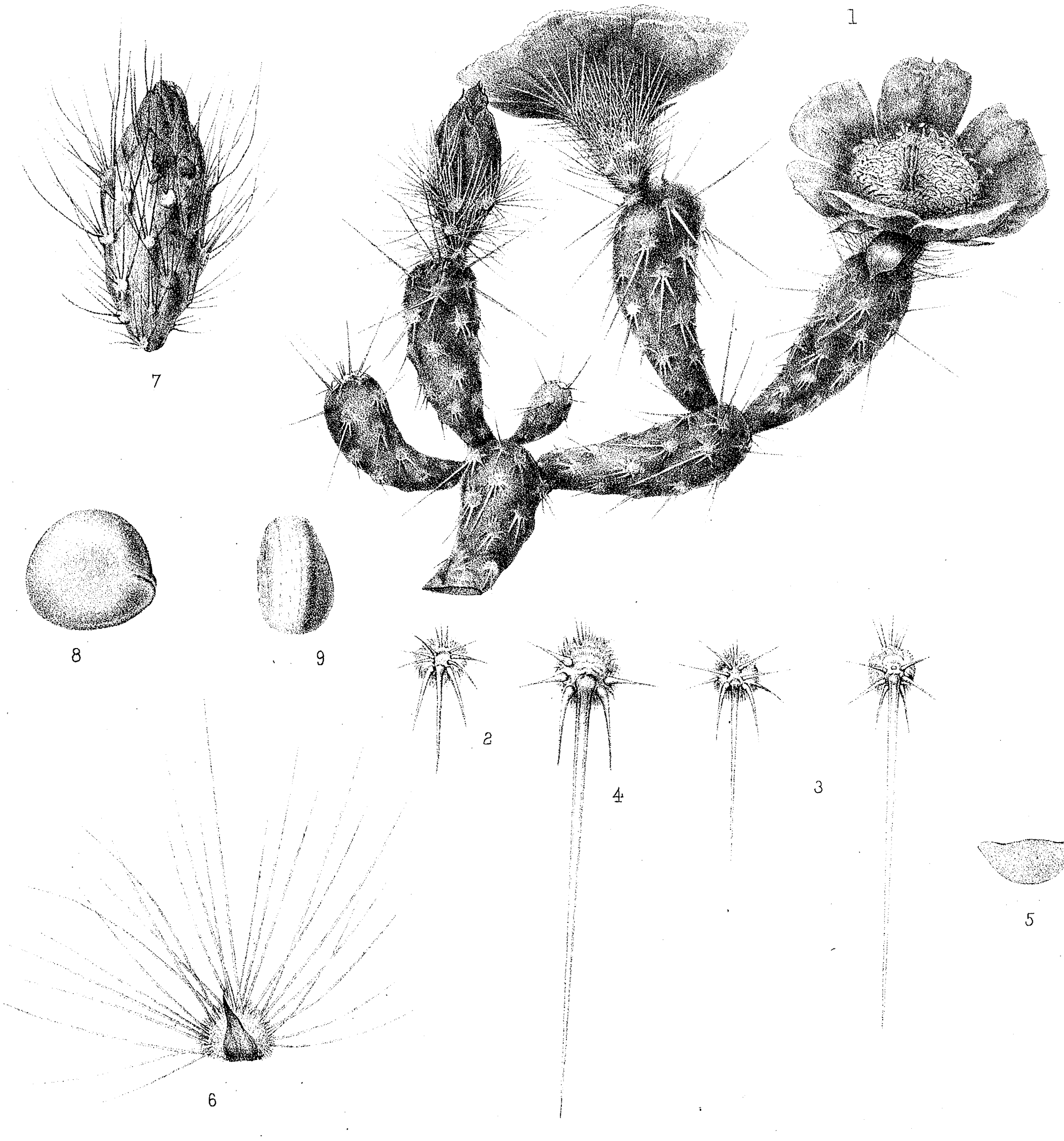

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OPUNTIA PULCHELLA, ENGELM.

APPENDIX N.

POPULATION AND RESOURCES OF THE TERRITORY OF UTAH.

BY

Dr. GARLAND HURT.

APPENDIX N.

POPULATION AND RESOURCES OF THE TERRITORY OF UTAH.

By Dr. Garland Hurt.

Captain Simpson to Dr. Garland Hurt.

Office Topographical Engineers, Department Utah,
Camp Floyd, U. T., March 1, 1859.

Dear Sir: I have just asked Mr. Gilbert who would be the best person to refer to for a statement of the population of this Territory, and he mentioned you. Now if you could give me such a statement, I would feel infinitely obliged to you, and would give you full credit for the same in a report which I expect to make to the Government on this subject. I would like to obtain the number and names of the towns and settlements, their respective locations, the population of each, the quality and extent of cultivable soil in their vicinity, the kind and quality of minerals, the saw and grist mills, factories, and other items of information which would be interesting to the public. If you could furnish this information in part or whole, you would be doing the public a great service, and me a very considerable favor.

Very respectfully, your obedient servant,

J. H. Simpson,
Captain Corps Topographical Engineers.

Dr. Garland Hurt,
Great Salt Lake City.

Dr. Hurt's reply.

Salt Lake City, U. T., *March* 5, 1859.

Dear Sir: Your letter of the 1st instant requesting information respecting the towns, population, agricultural and mineral resources, &c., of the Territory of Utah, is just received; and I would say for the present, that while I distrust my qualifications for furnishing such information as will be satisfactory, I shall, at the earliest opportunity, take pleasure in endeavoring to do so.

Yours, truly,

Garland Hurt.

Capt. J. H. Simpson,
Corps Topographical Engineers, Camp Floyd.

AN ABSTRACT STATEMENT OF THE POPULATION, RESOURCES, ETC., OF THE TOWNS AND SETTLEMENTS OF UTAH TERRITORY, MARCH 10, 1859, BY DR. GARLAND HURT.

Brigham City is the county-seat of Box Elder County; has a population of about 800, 1 saw-mill, 1 flouring-mill, and about 2,000 acres of land in cultivation, mostly of a dark, alluvial soil, well adapted to the cultivation of wheat, oats, barley, and potatoes.

Willow Creek has a population of about 600, 1 flouring-mill, and 1,000 acres of land of a quality similar to that at Brigham City.

There is a scattering population in this county of about 400, making the entire population of the county about 1,800.

About 6 miles south of Willow Creek are the Red Springs, so called from the color of the sediment precipitated along the course of the stream formed by them. They afford water enough to propel any ordinary kind of machinery. The water is of a temperature considerably above animal heat.

Ogden City is the county-seat of Weber County; has a population of about 2,000, 1 saw-mill, 1 flouring-mill; and a court-house has been commenced, but not finished. There are about 3,000 acres of land in cultivation in its vicinity, of a quality similar to that above described.

Ogden Hole has about 600 inhabitants, 1 flouring-mill, and about 1,000 acres of good land in cultivation.

Weber Fort has about 400 inhabitants, 1 saw-mill, 1 flouring-mill, and about 600 acres of land in cultivation.

There is also a scattering population in this county of about 600, making the entire population of the county about 3,600.

Farmington is the county-seat of Davis County, and has a population of about 1,000, 1 saw-mill, 1 flouring-mill, a court-house not quite finished, and about 2,000 acres of land in cultivation.

Centreville and its vicinity has a population of about 1,000, 1 saw-mill, 1 flouring-mill, and about 2,000 acres of cultivable land, of a quality similar to that at Ogden City.

There are several other small settlements in this county, embracing a population of about 800; making the entire population of the county about 2,800.

Six miles south of Centreville are the noted Hot Springs, with a temperature but little below boiling-heat, and too well known to require a description at present.

Great Salt Lake City is the county-seat of Salt Lake County, and has a population of about 8,000; several public buildings, the most imposing of which are the new court-house (unfinished), the Tabernacle, the church-store, council-house, and the Social Hall; but, above all these, Brigham Young's superb mansion and Lion House tower with quite an oriental magnificence.

The foundation of the Mormon Temple has been laid upon the Temple Block, and in the spring of 1857 about 300 stone-cutters were engaged in preparing the materials for the building; but (*mysterious are Thy ways O! Lord*) on the announcement of the advance of troops toward Utah, the sound of the war-bugle succeeded the sharp clink of the mason's chisel. The consecrated earth has been carefully restored, and I am informed that no trace of the foundation-work is now to be seen. If this temple should ever be completed, it will be one of the most imposing edifices upon the American continent.

There is a cloth-factory, a sugar-factory, a nail-factory, and several flouring-mills in the suburbs of the city, and about 4,000 acres of fertile land in cultivation.

There are several other small towns in this county, but unimportant, except as forming the habitations of the inhabitants of the farming and grazing districts, and, taken together, afford a population of about 6,000, making the entire population of Salt Lake County 14,000.

Tooele City is the county-seat of Tooele County, and has about 800 inhabitants, 1 saw-mill, 1 flouring-mill, and about 1,000 acres of cultivable land, somewhat inferior to that about Salt Lake City, but produces fine crops of wheat, oats, melons, and potatoes.

Grantsville and E. T. City are villages in the same county, and have each about 400 inhabitants, and about 600 acres of land in cultivation, with a saw-mill and flouring-mill in the vicinity of the latter; making the entire population of this county about 1,600.

Provo City is the county-seat of Utah County, and has a population of about 4,000, 2 flouring-mills, 1 saw-mill, 1 carding-machine, 1 pottery, and about 4,000 acres of land in cultivation in its vicinity, most of which lies upon the banks of the Timpanogos, and near the shore of Lake Utah, and is unsurpassed in fertility by any land in the Territory.

Springville is next to Provo in point of importance, and has about 2,000 inhabitants, 2 flouring-mills, 1 saw-mill, 1 shingle and lathing machine, and about 2,600 acres of land in cultivation of a quality similar to that at Provo.

Springville is a thriving village of enterprising people, but the tragical murder of Potter and the two Parishes, in the spring of 1857, must ever cleave like bird-lime to its history.

Spanish Fork has about 2,000 inhabitants, 1 flouring-mill, and about 2,000 acres of land in cultivation. The land on this stream contains a slight admixture of lime and gypsum, and is celebrated for fine crops of wheat.

A large proportion of the inhabitants are Danes, living in excavations under ground, poorly clad, but industrious and frugal.

Pond-town has about 300 inhabitants, 1 saw-mill, and about 400 acres of land in cultivation.

Payson has about 1,000 inhabitants, 1 flouring-mill, and a saw-mill and lathing-machine in its vicinity. It has about 1,500 acres of cultivable land.

Santaquin has about 300 inhabitants, 1 saw-mill, and about 600 acres of land in cultivation.

Lehi, Lake City, and Pleasant Grove are situated on the northeastern shore of Lake Utah, and have each about 800 inhabitants, 2 flouring-mills in their vicinity, and about 1,500 acres of land in cultivation at each place.

Mountainville, situated in the same neighborhood, has about 400 inhabitants, a saw-mill, and about 600 acres of land in cultivation, making the entire population of Utah County about 12,400.

Nephi is the county-seat, and the only settlement, in Juab County; has about 600 inhabitants, 1 saw-mill, 1 flouring-mill, and about 1,000 acres of land in cultivation, of a quality similar to that at Spanish Fork.

Mount Nebo, the highest peak of the Wah-satch Mountains, is in this county. Salt Creek Cañon, about 2 miles east of the town, is at the foot of Mount Nebo, and is composed on the southeastern side of a solid mass of gypsum, more than 2,000 feet high, which crops out at several points along the side of the mountain for a distance of several miles, showing the quantity inexhaustible. Farther up toward the source of the creek, large beds of rock-salt crop out near the base of the mountain.

Manti is the county-seat of San-pete County, and has about 600 inhabitants, 1 saw-mill, 1 flouring-mill, and about 1,200 acres of land in cultivation. At the base of the mountain, within the limits of the town-corporation, is an extensive quarry of limestone, well adapted for building-material and extensively used by the inhabitants. About 12 miles west of this town is an extensive stratum of stone-coal, much resorted to by the blacksmiths of this and the adjoining counties.

Fort Ephraim has about 600 inhabitants, 1 flouring-mill, and about 1,000 acres of land in cultivation. Extensive tracts of rich meadow-land lie in the vicinity of this settlement. All the tillable land in this county is fertile, and produces abundant crops of wheat, oats, and potatoes.

Fillmore is the county-seat of Millard County, and the destined capital of the new State of Deseret, and has about 800 inhabitants, 1 saw-mill, 1 flouring-mill, and about 1,200 acres of land in cultivation. The state-house at this place, built in 1854 of red sandstone, is one of the most imposing edifices in the Territory. It is designed as the left wing only of the future capitol of the new State. There is a scattering population in this county of about 200.

There is a small settlement in Beaver County, the population and resources of which are unknown to me. The county is said to be better adapted for grazing than agriculture.

Par-o-wan is the county-seat of Iron County, and has about 800 inhabitants, 1 saw-mill, 1 flouring-mill, and about 1,000 acres of cultivable land.

Cedar City, eighteen miles below Par-o-wan, has about 2,000 inhabitants, an iron-manufactory, 1 saw-mill, 1 flouring-mill, and about 3,000 acres of cultivable land.

Stone-coal, iron-ore, and native sulphur are abundant in the vicinity of this settlement. There is a scattering population in this county of about 400.

Harmony is the county-seat of Washington, has about 600 inhabitants, and about 1,000 acres of cultivable land.

A rich mine of lead-ore has been discovered in this county, near the Vagas, from which the Mormons undertook to supply themselves during the war with the United States; but it is said to contain so large a percentage of silver that it could be profitably worked for that mineral.

The most remarkable event in the history of these two counties is the brutal massacre of 139 American citizens at Mountain Meadows, in September, 1857, by

Mormons and Indians, and the confiscation of their property to the so-called Church of Jesus Christ of Latter-Day Saints.

There are several small settlements in the remote counties, but I am not familiar with their population and resources.

Owing to the limited amount of water for irrigation, there is but little room for increasing the area of cultivable land at any of these settlements except at Provo and Ogden.

Perhaps the most valuable meadow-lands in the Territory are to be found upon the shores of Utah Lake. Extensive meadow-lands are also found in San-pete County, Juab County, and in the vicinity of Ogden in Weber County.

G. HURT.

CAPT. J. H. SIMPSON,
Corps Topographical Engineers, Camp Floyd.

Captain Simpson returns his thanks to Dr. Hurt.

OFFICE TOPOGRAPHICAL ENGINEERS, DEPARTMENT OF UTAH,
Camp Floyd, March 26, 1859.

MY DEAR SIR: The statement you have sent me, by the hands of Dr. Forney, of the population, resources, &c., of this Territory, I received last evening, and I cannot express my thanks too warmly for the trouble you have taken in furnishing it. The statistics you give I consider most valuable, and they will form an important part of the report of my reconnaissances.

I am, very respectfully and truly, yours,

J. H. SIMPSON,
Captain Corps Topographical Engineers.

DR. GARLAND HURT,
Great Salt Lake City.

APPENDIX O.

INDIANS OF UTAH.

BY

Dr. GARLAND HURT.

APPENDIX O.

INDIANS OF UTAH.

By Dr. Garland Hurt.

The following communication from Dr. Garland Hurt, who for several years was an Indian agent under the General Government in Utah, will be of interest to all who take an interest in ethnological subjects. I cannot agree, however, with the doctor in the idea which he appears to hold forth as to the original disparity of the races, and that any mode of treatment of the Indian tribes which ignores this doctrine, or rather which is based on the doctrine of the original unity of the race, must be attended with failure. I know it is the habit of many excellent and scientific men, as the doctor has done, to leave out in their philosophy a great truth—the greatest that has been divulged to the world—that the great I AM has spoken to man in his ignorance, and has given to him certain primary truths, which if he regard, he will assuredly live in light; but which if he disregard, he will as assuredly walk in darkness himself, and lead others into darkness. Among these great primary truths, I hold, is the unity of the race; and before any one, in my judgment, has a right to disbelieve it, he must first show that the source of knowledge of the Holy One, the Bible, which unbelievers have as yet only served to strengthen by their cavils and objections, is untrue, and therefore unworthy of being received as the grand text-book of individuals as well as of nations. This the history of that work through the ages which are gone, its internal evidences, and its acknowledged bearing on the happiness of the nations of the earth which have sincerely embraced it, show they will never be able to do. So far from it, it is the belief of the writer (however it may be the fashion of the mere moralist to deny it and sometimes to deride it) the greatest specimen of statesmanship is yet to be exhibited in the condition of a kingdom whose controlling officers shall be like Joseph and Daniel of Bible history and Washington of modern times, whose only fear seems to have been lest they should do wrong and run counter to the Divine mind.

Dr. Garland Hurt to Captain Simpson.

Washington, D. C., *May* 2, 1860.

Dear Sir: In reply to your inquiries for information concerning the Indians in the Territory of Utah, I would remark that numerous tribes are designated by persons living in the Territory, which, in my opinion, are susceptible of the following divisions and subdivisions, viz:

Utahs: Pah-Utahs, Yamp-Pah-Utahs, Cheveriches, Pah-Vantes, San-pitches, Py-eeds.

Sho-sho-nees: Snakes, Bannacks, To-si-witches, Go-sha-Utes, Cum-um-pahs.
Py-Utes.
Wah-shoes.

The two latter tribes inhabit the country along the eastern base of the Sierra Nevada Mountains, and are not sufficiently understood by me to enable me to speak of them in detail.

The San-pitches speak the Utah dialect, and consequently I have classified them as a subdivision of that tribe, though they are greatly inferior to them in many respects, and the Py-eeds appear to occupy the same relation.

The Go-sha-Utes appear to be a hybrid race between the Sho-sho-nees and Utahs, and the same may be said of the Cum-um-pahs, the difference between them growing out of their relations to the different bands or subdivisions of these two tribes. These mixed bands are known as the Diggers, and commonly called Snake Diggers and Ute Diggers. The Snakes and Utahs proper are well formed and featured, but of a darker complexion than the Indians of the plains east of the mountains.

They are fierce and warlike in their habits, and have been at war with each other for several generations, and are likely to continue hostile. Each of these tribes are also at war with other tribes whose territories border on their own. The Snakes are at war with the Crows and Blackfeet, and the Utahs with the Cheyennes and Arrapahoes. They both, however, profess friendship for the white man. It is the boast of the Snakes, under a chief named Wash-i-chee, that the blood of the white man had never stained their soil.

They occupy the country bordering on Snake River, Bear River, Green River, and as far east as the Wind River. These bands of the Snakes are well supplied with horses and fire-arms, and subsist principally by hunting. Formerly, the buffalo ranged in their country, and formed the principal game; but according to their own accounts, which appear to be corroborated by those of the early trappers, these animals disappeared from their range about thirty-five years ago, in consequence of the severity of the winter, and have not since returned.* At certain seasons, however, these animals visit the Sweetwater and Wind Rivers, whither the Snakes repair every summer and autumn to meet them, and this brings them in contact with the Crows, who regard them as trespassers, and have treated them accordingly, and hence the hostilities between the Snakes and Crows, which will be likely to continue so long as the buffalo continues to range upon these waters.

The inferior bands of this tribe, especially the To-si-witches (White Knives), inhabiting the Humboldt River—who take their name from a beautiful white flint, which they procure from the adjacent mountains, and use as knives in dressing their food—are a very treacherous people; and the Bannacks, Go-sha-Utes, and Cum-um-pahs are not much less so. These latter bands are in the habit of infesting the emigration-road between the Soda Springs and the Bear River and the head of the Humboldt, during the season of emigration to California; and it is believed, and, I think, not without plausible foundation, that persons residing within the setttlements of Utah encourage these spoliations by offering a market for the property thus obtained.

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* *Note by Captain Simpson.*—Governor Denver, when Commissioner of Indian Affairs, addressed a letter to Hon. Alexander H. Stephens, Representative in Congress, January 18, 1859, in reference to the proposed new Territory, including the gold-region of the Pike's Peak country, in which he says the following in relation to the range of the buffalo: "Herds of buffalo frequent the plains along the eastern sides of the Rocky Mountains, but none have ever been found farther to the westward. Indeed, there is scarcely any evidence that buffaloes ever crossed that rocky barrier. Their range seems to have been confined almost exclusively to the great valley of the Mississippi." The governor is here evidently wrong, for I have seen a number of skulls of buffalo in Echo Cañon, and in the upper part of the Timpanogos Valley, all showing that at not a very remote period the buffalo roamed west of the Rocky Mountains. Besides, Frémont, in his report of his second expedition across the Rocky Mountains, expressly states (p. 144) that the buffalo ranged west of these mountains up to 1838 or 1840; and the traditions of the Indians, as given above by Dr. Hurt, certainly corroborate it.

The Utahs proper inhabit the waters of Green River south of the Green River Mountains, the Grand River and its tributaries, and as far south as the Navajo country. They also claim the country bordering on Utah Lake and as far south as the Sevier Lake, as theirs.

They also subsist principally by hunting, and have the same traditions as to the final disappearance of the buffalo from their hunting-grounds that the Snakes have; and it is their efforts to penetrate into the territories of the Arrapahoes and Cheyennes in pursuit of their receding game that have entailed upon them a most destructive war, in which their enemies have the advantage in arms and ammunition, but not in bravery; for it is my opinion, from a familiar acquaintance with them, that there is not a braver tribe to be found among the aborigines of America than the Utahs, none warmer in their attachments, less relenting in their hatred, or less capable of treachery. So complex is their nature that to trust them it is necessary to understand them.

Owing to the disappearance of the buffalo, and the scanty supply of smaller game, which is continually growing less, these Indians are occasionally reduced to the most extreme state of want, and the weaker families are compelled to subsist upon roots, plants, and insects.

Some of the inferior bands of both Snakes and Utahs are almost continually in a state of starvation, and are compelled to resort almost exclusively to small animals, roots, and insects for subsistence.

Among the more vigorous bands, the principal employments are hunting, fishing, shooting, horse-racing, and gambling. All the labor except hunting devolves upon their females, who dress their skins, and make them into clothing or lodges or prepare them for the market. The father holds his female children as his slaves, and demands a stipulated price for them in marriage. Some of their females are well-featured and bring good prices, but generally a few buckskins or a pair of blankets will purchase a bride.

Their females are also excessively addicted to gambling. The mode of gambling with both sexes is quite similar, a number of sticks being used in place of cards. They are so infatuated with this arrangement that I have known parties of them to refrain from eating and sleeping for twenty-four hours at a time, and gamble, with but little intermission.

Between the Utahs proper and the Py-eeds there is a species of traffic which I believe is not known among any other tribes upon the continent. I allude to the bartering of children. So abject and degraded are the Py-eeds that they will sell their children to the Utahs for a few trinkets or bits of clothing. The Utahs carry these children to New Mexico, where they find a profitable market for them among the Navajoes; and so important is it in enabling them to supply themselves with blankets from the Navajoes, who manufacture a superior article of Indian blankets, that the trade has become quite indispensable; and so vigorously is it prosecuted that scarcely one-half of the Py-eed children are permitted to grow up in the band; and, a large majority of those being males, this and other causes are tending to depopulate their bands very rapidly.

These Py-eeds indulge in a rude species of agriculture, which they probably derived from the Spanish Jesuits, and perpetuate only as a matter of necessity, and that in the most primitive form. Their productions are corn, beans, and squashes. They have no farming-implements, and of course what they thus produce costs them twice the amount of labor that would be necessary with proper facilities.

The Py-eeds are perhaps the most timid and dejected of all the tribes west of the Rocky Mountains, being regarded by the Utahs as their slaves. They not unfrequently take their children from them by force. I have learned from the Utahs, however, that they much prefer obtaining them peaceably if they possibly can; but when pacific measures fail, some of their men prefer to take them by force than to be disappointed.

This is the band of Indians who the Mormons say committed the massacre at the Mountain Meadows in the month of September, 1857; but any one at all acquainted with them must perceive at once how utterly absurd and impossible it is for such a report to be true, for I feel safe in asserting that ten men well armed could defend themselves against the largest force that this band could muster.

Their religious ceremonies are quite simple and primitive, being nearly the same among them all. They recognize but one God, or Great Spirit, whom they call by different names among different tribes; but their conceptions of the attributes of the Deity are generally limited and erroneous. Smoking seems to be one of their religious ceremonies, and is generally indulged in with great solemnity, especially in their national councils.

They are very superstitious, and frequently attribute natural events to supernatural causes, as the changes and eclipses of the moon. Some of them have an idea that anything asked for on the first sight of the new moon will be granted by the Great Spirit.

The sun appears to be with the most of them the embodiment or representation of the Great Spirit, and supplications are frequently made to the rising sun as to a rational being. But in all these ceremonies, their conceptions seem to fall infinitely below a rational comprehension of the object of their adoration, and often developing an inconsistency not easily reconciled with an enlightened idea of true religious devotion.

Their family-relations are patriarchal, and the practice of polygamy is indulged. The marriage-ceremony, being very simple, is often celebrated privately.

In their funeral-ceremonies, the deepest grief is manifested sometimes by inflicting punishment upon themselves. They will, on the death of a principal person, kill their horses, burn their lodges and clothing, and not unfrequently sacrifice their prisoners, cut their hair very short, and refrain from food, in some instances going without eating or drinking for several days.

The females of the bereaved family observe the season of mourning with the most bitter lamentations, and for months after the death of a husband they greet the early morning with loud and piteous cries. But the warrior scorns to weep, and prefers to manifest his bereavement by cutting and carving his flesh, which he sometimes indulges to such an extent as to endanger his own life.

They have no literature, and can scarcely be said to have a history of their own tribes or families. The few traditions that have descended to them are too vague, indistinct, and disconnected to be relied on as a history beyond the first preceding generation.

They are firm believers in charms, legerdemain, and necromancy, and in the management of their sick these superstitious devices constitute their principal treatment, which their patients submit to with the most unbounded faith.

Each band has its medicine-man, whom they treat with great respect and partiality.

Among all the tribes of this region there is the same indisposition to habits of industry, indolence being the rule and industry the exception, and nothing but the keenest impulses of necessity can impel them to action.

But this characteristic they, I believe, only possess in common with all the inferior tribes of our species, and, with a view to their civilization, is an item worthy of much consideration. Intellectually they appear to be as well endowed as most of the native tribes of this continent; yet there seems to be a want of some of those higher intellectual endowments which render our own race progressive and so eminently fit us for the enjoyment of an enlightened government. The discussion of this subject involves a comparison of the races and invites an inquiry into the causes of the disparity that now exists between them, whether that disparity arises out of mental or physical inequality, or both; to what extent that inequality is capable of retarding their progress in the advancement of civilization, arts, and science. It appears to be the opinion of a large number of our modern philanthropists that all beings possessing the human form were originally endowed with an equality that ever forbids the idea of inferiority.

With an eye single to this similarity in physical form, they seem to overlook the mental inequality, or attribute it to a want of culture; and hence the misguided zeal for the improvement of many of the colored races, whose mental inferiority is a fixed and demonstrable fact, which must ever and inevitably define their position in the scale of political importance, and renders the idea of their future elevation to an equality with the Caucasian race utterly preposterous, and can only exist in the misguided wanderings of a perverted imagination. They have shown from their earliest generations their incapacity for any except the most simple forms of government, such as would assimilate them to some species of the gregarious animals, whom they approximate to in this respect and imitate as much as they do the higher orders of their own species.

The conclusions, then, to which we must arrive by this course of reasoning are obvious.

First. That by becoming the constant recipients of our care and sympathy their condition is temporarily ameliorated, but only so during the application of that care and sympathy.

Secondly. By amalgamation we elevate them at the expense of the degradation of the superior race.

Thirdly. By coercion they are made subservient to the intellect of the superior race, and made to bear the burden of their own subsistence, by controlling and directing their physical energies into the channels of usefulness. There is a misguided philanthropy which seems to be constantly directing our energies to the accomplishment of what in the nature of things is utterly impossible, and which it is the province of moral philosophy to correct.

These errors are exemplified in the attempt of our Government, at the expense of millions of treasure, to improve the moral and social condition of the aborigines of the country, who continue to sink lower in degradation and want, and are annually diminishing in numbers. While a small African colony, in the Southern States of the confederacy, under what some are pleased to style tyranny and oppression, have swelled to a powerful nation, infinitely more happy than the Indians or than themselves could be without the controlling influence of the superior race.

These Africans, we repeat, are infinitely more happy and prosperous than it were possible for them to be without the controlling influence of the superior race; while at the same time, instead of diminishing they contribute to swell the sources of the national revenue.

Very respectfully, your obedient servant,

GARLAND HURT.

Capt. J. H. SIMPSON, *U. S. A.*

WASHINGTON, D. C., *May* 5, 1860.

DEAR SIR: Your very valuable letter, in relation to the Indians in Utah Territory, I have just received and read with a great deal of interest. It will constitute an important portion of my forthcoming report. I agree with you in all you say, except as to the original disparity of the races, and the impossibility of their restoration to the same level of physical, mental, moral, and religious condition. The same God who has for wise purposes permitted the degradation of some portions of the human family, can also by His Spirit so breathe upon mankind as to cause them, through the purchased redemption of His only beloved Son, to see each other eye to eye, and to delight themselves in the common blessings of one united family. This view is perfectly consistent to my mind with the coercion, for a time, of the inferior races to labor, of which you speak, and which I believe is one of the divinely appointed means to that end.*

Very respectfully, yours,

J. H. SIMPSON,
Captain Topographical Engineers.

Dr. GARLAND HURT.

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*And I might have added that the history of Cherokees, Creeks, Choctaws, Chickasaws, and other tribes in our own country, including the Pueblo Indians of New Mexico, as also that of the inhabitants of the Sandwich Islands, is confirmatory of my position.

APPENDIX P.

REPORT

ON THE

LANGUAGES OF THE DIFFERENT TRIBES OF INDIANS

INHABITING

THE TERRITORY OF UTAH.

BY

LIEUT. C. R. COLLINS,
TOPOGRAPHICAL ENGINEERS.

APPENDIX P.

REPORT ON THE LANGUAGES OF THE DIFFERENT TRIBES OF INDIANS INHABITING THE TERRITORY OF UTAH.

BY LIEUT. C. R. COLLINS, TOPOGRAPHICAL ENGINEERS.

WASHINGTON, D. C., *August* 30, 1860.

SIR: Having received instructions from you to arrange the several lists of Indian words which you have collected in your recent explorations, in a form suitable for the purposes of comparison, I accordingly submit the accompanying comparative vocabulary which I have drawn up, together with a statement relative thereto.

The vocabularies furnish specimens of the languages of the *Utes* or *Utahs*, the *Shoshonees* or *Snakes*, the *Pi-utes*, and the *Washoes*, together with a few numerally, of the *I-at* language.

The result of an examination and comparison of these languages shows quite a similarity between the Ute or Utah, the Shoshonee, and the Pi-ute; while the Washoe is apparently quite distinct in its characteristics.

The few I-at numerals which are given are insufficient for the purposes of classification.

The resemblance of the first three languages to each other seems quite sufficient to warrant the conclusion that they have a common origin, and that the corresponding tribes should be placed in the same primary ethnological group.

This classification is based entirely on the resemblance of language, shown by the vocabulary; it is possible, however, that tribes living in contact with each other may acquire a similarity of language by the adoption of members of one tribe into the other. Captives taken and absorbed into the tribe must necessarily have an influence upon the language. A minute examination of the construction of the language, and particularly of the declination of the verbs, would be a more accurate method of comparison, but would require more material than we at present possess.

In the ethnological classification of Indian tribes given by Schoolcraft, he applies the name of *Shoshonee* to the fifth primary group, located, according to his report, "in the Rocky Mountains, the higher Red River, and the hill country of Texas; and embracing the *Shoshonees* or *Snakes*, the *Bannacks* or *Root-diggers*, and the *Comanches* of Texas." If we assign a place in this group to the *Utes* or *Utahs*, and the *Pi-utes*, it will extend its area westwardly to the base of the Sierra Nevada.*

Further ethnological investigations may result in ascribing to other unclassified tribes a place in the same group.

The language of the *Washoes* appears to bear no resemblance to any of those given in Schoolcraft's collection of vocabularies, nor does it seem to be at all related to the *Shoshonee*.

There is a source of error and difficulty in instituting a comparison between specimens of Indian languages, which arises from the method of obtaining them. The vocabularies are frequently obtained from *different* individuals, who, of course, attempt by the use of the English alphabet to represent the sounds of the words as pronounced by the Indians from whom they are obtained; it is probable if several persons attempt, in this way, to indicate the same Indian word, no two of them would represent it in the same manner, or by the same letters; moreover, as the word is uttered in the Indian's characteristic guttural manner, and there being in an unwritten language no authority for correct pronunciation, the peculiarity of each individual's utterances is likely to be perpetuated in vocabularies made from information obtained from them.

There are several words of different languages in the accompanying vocabularies, which, though spelt differently, are undoubtedly meant for the same words, or at least are derived from the same source; in such cases the sounds of the words, as they are pronounced, generally bear more resemblance than their appearance as they are represented.

Among the cases of similarity of words from the *Ute*, *Pi-ute*, and *Shoshonee*, we find *Pah*, meaning water, to be common to all of them, and it may also be remarked the same word means water in the language of the *Pueblo* Indians of *Jemez* and *Old Pecos*, as given in vocabularies previously obtained.†

The words for face, eye, mother, house, sun, ice, snake, with several others, are common to all of the languages here given, except the *Washoe*, while there are others, which so nearly resemble each other as to point to a common origin, if indeed they are not intended for the same word; these are found in the Indian for nose, beaver, day, summer, winter, &c.

There are frequent instances in these languages of compound words being formed by the union of two or more elementary ones; in some of these cases we know the meaning of all the syllables, or component words; in other cases, some of them may be recognized, and the meaning of others inferred from the meaning of the entire combination. Allowance must be made for the elision due to the junction of several independent words in a compound one. *Pah*, meaning water, occurs as a syllable in the word *Pah*-emp, which means rain; the latter syllable being in all probability derived from *Too-oomp* or sky, thus making *Pah-oomp*, *Pah-emp* or sky-water.

Hail is *Pah-oo-ump;* ice, *Pah-kup;* the element *Pah*, also enters into the words for otter, beaver, duck, and fish, in one or the other of the dialects here given.

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* Since writing the above I have observed that Prof. W. W. Turner has also placed the *Utahs* and *Pi-Utes* in the *Shoshonee* group; and has also connected the *Kioway* tribe with the same family. (Pacific Railroad Reports, vol. iii.)

†Journal of a military reconnaissance from Santa Fe, New Mexico, to the Navajo country, in 1849, by Lieut. J. H. Simpson, Corps Topographical Engineers.

The notes which are appended to the vocabulary, give all the necessary information with regard to the arrangement of the different lists of words furnished by their respective authorities.

Very respectfully, your obedient servant,

C. R. COLLINS,
Brevet Second Lieutenant Topographical Engineers.

Capt. J. H. SIMPSON,
Corps Topographical Engineers.

A comparative vocabulary of Indian words.

English words.	Name of tribe.			
	Ute or Utah.[1]	Shoshonee or Snake.[2]	Pi-Ute.[3]	Washo.[4]
God	Shi-ne-babe		Nis-mer-nah	Ti-oni-le.
Devil	Shi-neb	Pi-an-dant	Su-ti	Sem-em-she.
Man	To-wats	Tine-up	Na-na	Sa-li-hou.
Woman	Mam-a-shodo	Wipe	Mo-goh	Se-moh-moh.
Boy	I-pids	Yam-bau	Nat-che	Ma-hou.
Girl	Nange-it	Nah-wich	Tu-ah	Shoul-cum-hough.
Infant, child	Pae-shutz	Tur-ra-fu-ritz	O-ah	Be-gus.
Father	Maw-ah	Ap	Nah	Ta-grih.
Mother	Te-ah	Be-ah	Be-ah	Te-lah.
Husband	Pu-um	Be-wah	Go-mah	Te-bu-mah-le.
Wife	Mah-show-er	Goo-up	No-dug-we	Tun-lian.
Son	To-watz	An-doo-ah	Ud-du-ah	Teng-ane.
Daughter	Pa-ditz	Bi-deh	Ur-bur-dah	Teng-am-ough.
Brother	Tschodge	Dam-mie	Ur-bah-beh	Te-bag-ough.
Sister	Nah-ninge	Nah-wie	Ha-ma	Te-e-sah.
Indian	Noontz	Nu-uh	Ner-mer	En-you-geh.
Head	Tots-ute	Bam-by	Er-sud-pig	La-hep.
Hair	Tots-u-obe	Pong-gush	Wah	Ly-housh.
Face	Ko-bah	Go-bah	Ko-bah	Tic-maish.
Forehead	Hoo-tok-ut	In-gi	Eu-ah	Tic-ca-be.
Ear	Nun-go-bee	Ne-ink	Er-nok-ah	Tip-e-son.
Eye	Poo-ib	Boo-ee	Boo-ee	Te-we-gu.
Nose	Mo-wip	Mo-wy	Mo-be	Te show-e-yep.
Mouth	Tumb-bwap	Tam-bah	Do-bah	Te-hung-ah.
Tongue	Ah-woomp	Igk	E-quah	Tic-mah-doudt.
Tooth	Tah-ump	Muntz	Da-mah	Cey-yect.
Beard	Muns-ump	Go itch	Mas-su-e	Chec-mel.
Neck	Pah-weep	Go-itch	Goo-tah	La-bou.
Arm	Poor-ub	Boor-rah	Ber-tah	La-bough.
Hand	Mu-ur-ve	Maw	Mi-ee	La-dough.
Fingers	Mah-shub	Mas-suck	Ma-gon	De-too-le-sic.
Nails	See-joomb	Mas-sit-dah	See-doo	De-loo-lepe.
Body	Womp-tahb	Kaw-y	Ner-wah	Lah-get.
Belly	Shaugh-ab	Nuh	Coo-he	La-yoh.
Breasts	Ning-oop	Shonk	Ning-oh	Lem-bah.
Man's privates	Wap	Woo-ah	Be-gsh	Te-mon-cush.
Woman's privates	Nig-ump	Die	Sou	Tee-bess.
Leg	Pung-a-boo	Bung-gup	Con-op	Lah-hul.
Foot	Nam-bap	Nump	Ger-ger	Te-my-yept.
Toes	Pee-ret-tombe	Tash-e-toh	Doh-goh	Dee-too-le-sic.
Bone	Obe	Tats-se-oh	Oh-ho	Teah-be.
Heart	Peep	Be	Be-wa	Lew-lah.
Blood	Pap	Fru-up	Per-pe	Tah-soong.
Town, village	Kant	Tah-ah-tits-kau	Nak-got-eh	Teng-a-la-me-lou.
Chief	Ne-ab	Ti-gon-up	Nar-bun-ah	Too-bag-ou.
Warrior	Ni-uk-ne-ab	Noo-ve-ting-up, chana-shun-be-nah.	Nak-ko-et	Co-me-sou-co-leh.
Friend	Tig-a-boo	Hinch, tig-ga-boonch	Ber-ah	Sou-la-deh.
House, hut	Kant	Kant	Na-vie	Lang-ell.
Cup	Kar-tridge	A-woo	Ge-tah	Ching-ou-na-me.
Kettle	Pam-boont	We-wib-too-ah	Op-oh	Ka-wa-lou.
Bottle	Too-pootz	Too-pe-otz	O-tah	Ca-tep.
Arrow	Ou-as-in-too	Hoo-pah	Po-oush	Mas-ke-set.

Vocabulary of Indian words—Continued.

English words.	Name of tribe.			
	Ute or Utah.	Shoshonee or Snake.	Pi-Ute.	Washo.
Bow	Hadz	Ide	Ah-durg	Tak-loh-hot.
Ax, hatchet	Me-pood-pen-en	Oo-hun-ne	Wer-suk-en	E-car-sen.
Knife	Ou-witz	We	We-he	Tow-eng-an-yeng.
Canoe, boat	Ur-ve-shock	Pe-ah-vunk	Sack-ke	Ta-nup.
Moccasins, shoes	Pats	Namp	Moc-co	Te-mo-cougs.
Bread	Pan, (same as Spanish)	To-she-kik-up	To-hut-eca-ba	Tem-lou.
Pipe, calumet	Soonk	Pitch-shemo	To-esh	Bang-dus-duc.
Tobacco	Quap	Too-pah	Pa-moh	Bang-cush.
Sky	Too-wint-up	Too-oomp	Coo-me-bah	To-ma-hum.
Heaven	At-too-wip	War-rah-so-up	Pe-sah	Cum-nac-sa-sa-seh.
Sun	Tap	Tap	Tab-ah	Tou-gil-ah-gu-sots.
Moon	Mur-toads	Moo-ah-tap	Mer-ah	Tee-bah.
Star	Poorts-ip	Tats-in-up	Pah-too-op-a	Mah-la-sung.
Day	Tat-be	Tah-be-dog-e	Tah-bee-no	Ah-bah.
Light	Pau-nin-night-te	Tah-ke	Tah-weep	O-dah-se-weh.
Night	Too-wint	Too-gan-ne	To-kan	
Darkness	Too-or-ip		To-kan-no	Tow-e-day-e-you.
Morning	Itch-cooch	Po-etch-cush	Awa-mooc	Was-leh.
Evening	Tah-wy-e-cup	Tah-y-am-wie	Yong-on	To-pah-teen.
Spring	Tah-mant	Tah-ka-wit-pah-shur	Tad-sah	Se-gah-but.
Summer	Tady	Tods	Tod-yep-a	Am-suc.
Autumn	U-gwunt	E-by-ide	Eu-bau-a	Oh-osh.
Winter	Tom	Tar-kar-wan	Toh-moh	Ca-lesh.
Wind	Nerd	Noo-y	Hey-gwip	Ta-ge-ene.
Lightning	Pan-nuck-shet	Teme-bah-utch	Ter-qua-que-yepa	To-ah-osh.
Thunder	Nun-wint	We-ke	Ner-nah-ah-bah	Tah-hew-e-ach.
Rain	Pah-wars	Pah-emp	Pah-omah	To-ah-osh.
Snow	Nu-bub	Tah-kep-pe	Ter-gra-bah	Ta-dah-ash.
Hail	Pi-ab	Pah-oo-ump	Har gwa-dig-wa	Se-go-gum-oh.
Fire	Coont	Koo-nah	Coo-son	Teh-yo.
Water	Pah	Pah	Pah	Te-mah.
Ice	Pah-kup	Pah-kup	Pah-geh-o-va	Tou-ba-sut.
Earth, land	Too-wimp	Shock-up	Ta-pe	Ha-ow-wa.
Sea	Pah-wad-rid	Sin-ur-bah	Pah-ne-nad	Ta-hou.
River	Too-quint	O-gwint	Hoop	Wa-tah.
Creek	Me-poods-too-quint	Shock-o-bah	Toots-e-hoop	Too-goh-got.
Lake	Me-poods-pah-ardid	Pah-god-dan	Pah-ne-nad	Ta-hou.
Valley	You-ab	Pah-un-up	Yer-per	Ta-moh-wa.
Hill	Pi-ab	Toh-yup	Quid-du-ep	Tou-lou-oug-goh.
Mountain	Ki-be	Quid-u-went	Ki-ebe	Ta-lah-act.
Island	Too-witz-tuck-idge	Che-nump	Pah-soe-a-ted	Tou-me-you-tah.
Stone, rock	Toomp	Timp	To-be	Tah-ech.
Salt	Wi-ab	Ou-gwup	Oug-an-a	Ung-ah-a-per.
Copper	Ung-o-pah-nock-it		Won-con-you-dip	Wel-kep-kep.
Iron	Pah-nock-it	Port	*Same as knife*	*Same as knife.*
Maize	Co-me	A-nip	Corn	Corn.
Tree	Mah-ab	Op-koo-oer-vant	O-sag-mag-wa	Ki-osh-le.
Wood	Oo-quep	Tsick-up	Koo-nah	Tou-lou-bul.
Leaf	Nung-ah-up	Shamp	Ah-noc-ah	Tou-yah-yet.
Bark	Hash-soop	Ike	Wah-ac-cat	Mah-to-kip-te.
Oak	Que-ub		We-eb	Mal-nah-ge.
Pine	Ah-oomp	Won-go-up	Wo-cue-be	Sou-wah.
Flesh, meat	Too-quab	To-queah	Ah-ber-did-doc	Ta-push.
Beaver	Pah-oontz	Hau-witch	Pah-u-nak	Tah-nesh.
Otter	Pah-vit-zook	Pahn-sook	Pah-n-sang	Cha-wa-wa.
Deer	Too-e	Too-pe	Der-herd	Mem-tah-we.
Grass	Oo-gwoob	Show-nip	Wha-hab-e	Hor-se-pe.
Bison, buffalo	Kootz	Go-witch	Cud-sou	Go-sou.
Bear	Que-aut	Neer-ah	Pad-wah	Ta-ba.
Wolf	Yo-woods	So-wor-rah	Esh-sah	Too-le-seh.
Dog	Cha-ridge	Char-re	We-seg-wog	Cho-coh.
Fox	Tah-bon-ditz	Warn-nes	Wah-he	Mo-gup.
Squirrel	Spiss	Ku-ump	We-dane	Ou-che-le.
Rabbit, hare	Chuck-am	Tap	Cam-me	Pah-lou.
Snake	To-wab	To-quah	To-quah	Ma-a-kee.
Bird	Wid-didge	Te-hunty	Hood-ye-bah	Geh-yonk.
Egg	Nah pab	Po-wood-ge	Ar-no-naugh	Ti-oh-gul.
Goose	Hah-bah-munk	Ne-gunt	Na-giner	Sam-urk.
Duck	Tsug	Pah-e	Per-her	Te-lach.
Chicken	Ham-bung	Shy	Que-nah	Pat-se-en-neh.
Pigeon	Hy-you-en-booug	Hone-dah	Pan-he-ob	Oug-a-hah-di-al-el.
Partridge, (sage hen)	Shee-jeh		Wee-hoop-o-ah	Wah-tel-ah-leh.

Vocabulary of Indian words—Continued.

English words.	Name of tribe.			
	Ute or Utah.	Shoshonee or Snake.	Pi-Ute.	Washo.
Turkey	Pan-dah-mo-witz		Tag-wan	Ou-wha-wee-ap.
Fish	Pah-gah	Pan-que	Pah-gue	Ou-wa-chee.
White	T-shard	Qui-chen	Tah-hoo-qui-dah	Tal-po-po-e.
Black	Too-gut	Hye	Too-hoo-qui-dah	Tal-e-ah-we.
Red	Un-guard	Unga-she-etz	At-soy-qui-dah	Tal-let-leg-eg.
Blue	Tchower	Show-e-tan	Po-eg-gui-dah	Tal-pel-pel-eg.
Yellow	Koi-run-gwat	O-up	O-shy-gui-dah	Tal-sah-se-meg.
Green	Quer-shower	Poo-y	Pe-ega-you	Tal-yah-yeh.
Great, big	Hah-bat	Pe-up	Pa-bac-co	Te-yel-ee.
Small, little	Me-poods	Too-e-gitz	Tot-se	Bah-hah-ging.
Strong	Toot-ten-gee	Too-a-gunt	Oh-hot-a	Tal-sus-sus-eh.
Old	Nan-nan-poods	Soo-a-putz	Moh-ed-dug-wa	Moh-la.
Young	Hah-grut	Hah-witch-che-pah	Pu-et-dub	Tash-lu-tee.
Good	At	Yah	Pe-sau-you	Tung-ou.
Bad	Hods-at	Ked-yant	Ser-ta-yo	Noh-seh.
Handsome	At-um-boon-e-kah	Sa-na-boo-nit	Pe-sa-tah-wep	Oung-oh-we.
Ugly	Hudy-at-boon-e-kah	Ked-sa-nav-oo-wint	Ser-tah-tah-wep	Na-se-eh.
Alive, life	Kody-e-eye	Ka-de-ite	Yert-sung-oh	Yae-e-gep-see.
Dead	Yae-quah	De-ah	Yah-eph	Yo-leh-ee.
Death	Yae-quah	De-ah	Car-de-ma-nicka	Yo-leh-ee.
Cold	Shoop-pwi	E-gint	Ah-dit-se	Tah-was-ka-me.
Warm	Koo-toor-idy	Kah-shit-come-it	Ah-dit-re	Yo-och-rosh-e.
I	Moon-eh	Ne-ah	Ner	La.
Thou	Oom	Ne-ah-mah	Er	Hah-de.
He	Munk	Ich	See-meh	Wak-la-oh-se.
We	Noomp		Tah	Yes-se.
Ye	Moont		Tah-he	*Same as we.*
They	Mah-pat		Er-mir	Teh-eh.
This	Inch		Esh-su	Weh-de.
That	Match		O-ate	*Same as though.*
All	Mah-noon-e		Ser-wa	Meh-lou.
Many, much	Hab-bon	Shout	E-wa	Kah-kahn.
Who	Hung-e		Ha-goh	Go-de-ah.
Near	Tah-ve-noonk		Za-ko	Tah-wad-eh.
Over	Quand-doo		Ac-qui-nog-wa	Kah-wah.
To-day	Tab-by		Tah-ho	Ah-leah.
Yesterday	Ker-erd		Ee-gee	So-at.
To-morrow	Ate-shook	Po-e-chick	Moh-ha	Wat-le-e-yo-geo.
Yes	Hoo-qua	Osh	Ha-ha	Hea-ha.
No	Kods	Kay-ah	Ki	Ac-tag-go.
And	Tam-me		Toh	Tah.
Times, (Fr. *fois*)	Kodz-in-e-tog-e		Me-no	Coo-yah.
Eat	Tuck-e	Took-she-wan	Tuk-ka	Sam-la-yea.
Drink	He-be	Hope	Hep-pe	Sem-ma-yea.
Run	Tog	No-ke-wie	Po-yo-a	Mo-o-see.
Dance	Wippy	No-ah-gin	Net-ga	Lo-see.
Go	Pi-re-que	Me-ag	Me-ah	Key-you-wa.
Come	Kike	Kim	Ke-mak	Pee-ya.
Sit	Kad-de	Cot	Cot-den	Ka-ka-le.
Stand	Woon-e	Woon	Wer-na	Ga-le-ee.
Sing	Ky-e	Tin-ne-koo-up-pun	Ton-ic-wer	Les-me.
Sleep	Pwee	Up-poo-e	Er-we	Les-she-mo.
Speak	Um-by-e	Ti-oog	Yad-wah	Te-ou-i-a-ge.
See	Pone-ne-keh	Poo-ek	A-bo-ne	To-le-ge-he.
Love	Ash-in-de	Ne-ah-cam-wang-yun	Pe-sana-so-bid	Te-com-ca-cam-see.
Kill	Py	Dots-sa-van	Ha-but-sa	Te-at-ke.
Walk	Pag-a-we	O-wid-dah-me-ah-kin	Me-oh-hoo-gok	At-tey-a-li-yu.
Bury	Too-gwe	Nah-goo-in	Ah-goh	Lem-i-yah-we.
Who is that?	Un-gah-rah	Ah-gin-ne-nau-ne-uk	Ha-ja-ou-sou	Go-ding-ah-hah.

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[1] Obtained by Captain Simpson from Pete (Un-go-bah), a Ute Indian, who accompanied him as interpreter.
[2] Obtained by Captain Simpson from Tar-a-ke-gan, a Shoshonee.
[3] Furnished to Captain Simpson by Major Frederick Dodge, Indian agent.
[4] Furnished to Captain Simpson by Major Frederick Dodge, Indian agent.

Vocabulary of Indian words—Continued.

English words.	Ute or Utah.	Shoshonee or Snake.
Cañon[5]	We-wuds	
Cottonwood	Shoyp	
To hunt	Pe-shan-gah	Mah-wake.
To hear		Mo-nan-ge.
Willow	Kan-ahb	
To trade	Nar-a-wop	Un-re-mo.
To talk	On-pah-ger	Tig-ren.

[5] The remaining words in the vocabulary were furnished Captain Simpson by Mr. Bean, interpreter and guide, 1858.

Vocabulary of Indian words—Continued.

English words.	Ute or Utah.	English words.	Ute or Utah.
Smoke	Queep.	Mouse	Widges.
Elk	Par-i-ah.	Cat[6]	Moo-sah.
Fly	Mo-pids.	Cricket	Un-sock.
Eagle	Guon-dich.	Grasshopper	Ahr-an-gige.
Feathers	Pe-ah.	Brier	Man-abb.
Crane	Tch-kore.	To meet	Toi-tia.
Trout, salmon	At-in-pah-gah.	To cook	Si-eh.
Mullet	Oo-bug-gah.	To preach, harangue	Om-par-ro-ah.
Chub	We-pah-gah.	To shoot	Ko-que.
Name	Ne-ah.	To gamble	Nah-a-witch.
Love	Pe-mits.	To hit the mark	We-nahr.
Gun	Tum-bu-you.	To miss the mark	Kar-en-qui.
Powder	Queets-owah.	Be still	Ah-gahr.
Lead	Ooo.	Finger-ring	Pan-a-mar-ger-nump.
Caps	Wun-ou-ad-jip.	Foot of mountain	Kan-ne-gub.
Flour	Tu-shu-kunt.	Side of mountain	Pi-ah-bah.
To tell	Pe-sheth-i-na.	Top of mountain	Wig-ki-bah.
To ask	Mi-bwan.	Sore stinking	Pe-keep.
To write	Po-quint-man-ik.	To put down	Rood-zee.
To travel	Pah-nt.	To hide away	Ah-gah-wod-zee.
To move camp	Me-an-bi-que.	To steal	Ee-ying-ah.
To go home	Pi-que-bau.	To fasten or tie	Tap-itch.
To guide	Me-ar-ogi.	To think or remember	Shu-mivi.
Blanket	Pan-shi-mo.	To make	Man-e-kish.
Want	Ash-en-ta.	To give	Mog-ie.
Sugar	Pe-ar-ai-kunt.	To load a gun	To-wods.
Crooked	No-ko-me.	To burn	Koot-sik-ee.
What kind?	Hag-arrh.	To glean	To-in.
This side	E-nunko.	To quarrel	Wah-am-bah.
The right side	In-en-to.	Where	Kuk-ah-bah.
The left side	Man-en-to.	To strike	Que-pi.
Yonder	Moo-ah.	What is the matter?	Mike.
Here	E-bwah.	I said	Mike-nig.
Away off	Mee.	Fight	Ni-o-que.
Close by	In chock-iba.	Angry	Niah.
Hole	Puk-age.	Nothing	Na-vash.
Whip	Wash-e-nump.	Another	Ko-mush.
Lariat	Tshap.	Looking-glass	Nah-voo-nah.
Meeting, gathering	Shu-par-ro.	To win	Quoi.
Rusty	Nah-shants-pe-nok.	To whip	Wit-te-push.
To go on foot	Nam-pah-ut.	To kindle a fire	Koo-ne-ni-te.
To go on horseback	Ko-wi-yo-tspee.		Koo-neen, yi-te.
To lay down	Ah-bee.	To rub	We-toots-pe-nok.
To get up	Quer-i-ka.	To grow	Nau-ni, nau-yi.
To sit down	Kar-e-wah.	To cut	Tskebin.
To camp	Me-a-bitch.	To dig	Ho-ri-eh.
What for?	Ah-kon-de-ga.	Handkerchief	Koo-ret-a-shap.
May be or probably	Um-pug-go.	Ramrod	Tskuri-nump.
Cedar	Wahp.	Flint	Wou-nup.
Piñon, pine	Teh-up.	Dry	Tab-ash-e-guipe.
Pine nut	To-won.	Wet or miry	Pah-we-up.
Fir, balsam	Ohmp.	Wagon	Oo-yem-bung-go.
A spring	Tspe-kin.	Canteen	O-chalts.
Awl	We-uds.	Brass kettle	Woker-pam-pou-a.

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[6] The word for Cat given by Mr. Bean is Mo-pids. As he gives the same word for Fly, I have taken the word Moo-sah, which is given for cat, from the vocabulary of Ute words in Captain Simpson's "Journal of a Reconnaissance in New Mexico in 1849." (See Ex. Doc. No. 64, Senate, Thirty-first Congress, first session, page 142.)

Vocabulary of Indian words—Continued.

English words.	Ute or Utah.	English words.	Ute or Utah.
Middle of a thing	Toi-teo-re-roup-punt.	A few	Nan-e-soos.
Cane grass	Pah-gamp.	To shake hands	Moot-sic.
Wire grass	Soe-neep.	To smoke tobacco	Quot-tik-ub-bah.
Coarse grass	O-won-eh.	To go slow	Shan, eep-pah-nt.
To laugh	O-kee-ung-kah.	Midnight	To-i-to-wun.
To cry	Yog-ie.	To-day	Ahp-tab-i.
To kick	Tang-ie.	Time past	Etish.
To take	Kwee.	Now	Ahb.
To catch	Tsie.	After awhile	Pe-nun-ko.
To lasso	We-tsung-ga-wunk.	Very	Tu-ege.
To drive	Tow-washo.	What	Ump-wah.
To herd	Poo-ne-woo-ne.	When	An-oke.
Crow or raven	At-tok-nuts.	Truth	Shumb.
Wolf, (small)	Yodes.	Lie	Tu-ish-er-a.
Backbone	Ho-app.	Horse	Ko-wi-yo.
Ribs	Ow-at-in-bope.	Saddle	Kart-e-nump.
Money, silver	To-shau-pan-a-kañe.	Bridle	Tim-bi-up.
Gold	Waw-pan-a-kañe.	Spur	Tang-i-nump.
Skin or hide	Pove-ah.	Ox	Gets-m-bun-go.
To trot	Pove-yah.	Thick	To-mun-ter.
To gallop	A-po-nah.	Thin	Ko-puk-age.
To stop	Ar-rik-in.	Fat	Yope.
Up above	Pan-unk.	Lean	Kan-n-bitts.
Down below	Pat-sau-unk.	Rich	At-t-nooch.
Say	Ah.	Poor	Tah-gah-pids.
Enough	Oo-na-shump.	Noon	To-i-táb.
Just like	To-an-ow-er.	Cow	Peads-guets-m.
Together	Now-ah.	Horn	Op.
Shirt	Tah.	Cup	Pan-a-koots.
Coat	To-mun-ter-tah.	Spoon	Munt-sook.
Pantaloons	Pemo.	Corn	Koo-me.
Vest	Nah-voo.	Wheat	O-wee-bi.
Leggins	Koose.	Potatoes	We-choon.
Hat	Ki-cho-che.	Squash	Par-ang-ah.
Fall	Pant.	Melon	Shon-ti-kut.
Short	To-bwik-ah.	Sweet	Pe-og-o-munt.
Long	Pa-out.	Sour	Shig-un-tug.
Heavy	Put-te-ant.	Full	Pat-suk-unt.
Light	To-be-puds.	Empty or all gone	To-pit-wa.
To fly	Widge-gue-nung.	Hungry	Tig-i-na-ra.
To understand	Pe-su-ge-wa.	Thirsty	Tong-oou-yay.
All the time	Te-shump.	Sack	Quon-up.

Sentences in English and Utah.

English.	Ute or Utah.
Friend, what do you call this?	Tick-a-boo an-a-ne ah-inch?
I do not know	Tami-i-kotch pe-su-ge-wa.
Where are you going?	Um huk-ah-ba pi-qua?
I am hunting horses	Tam ko-wi-yos' pe-shaw-ger.
May be I saw them yesterday	Um-pug-go tam kuhn poo-in-ka.
Where? do tell me	Huk-ah-bah-oo ish pe-sheth-i-na.
Yonder, the other side of the mountain	Mov-ah inch-kibe quan-ko-up.
I am very hungry	Tam-i-tu-eye tiz-u-na-ra.
I have plenty; you eat with me	Tam hov-on kar-re um-now-ah ti-ki.
Very well, my friend	Tu-ege toy tik-a-bun.
When will you come back?	Um an-oke pe-nun-ko-pe-jee?
May be in one month	Um-pug-go-soos mat-och-yay.
Where will you camp to-night?	Un huk-ah-bah me-a-bitch ahp-to-wun?
Here, close by the spring	E-bwah su-chock-i-ba tspe-kin.
Where is the next water?	Huk-ah-bah ko-mush pah-kar-re?
Yonder, in the middle of the valley	Morah toi-ter-re-wup-punt inch u-ab.
Is there another good road?	Ko-mush at poh-kar-re-ah?
Yes, up this cañon	Oo-wah inch we-wuds pen-unk.
I am now going	Tam ahp pi-qua.
I say give me some bread	Oo-ash-ah tsho-tik-up mo-gie.
I have none; it is all gone	Kats-kar-re-mon-ona tu-pik-wa.
Who ate it all?	Aug-i mon-oke tik-ie?
Your father and mother	Um mo-ants pe-ads non-ah.
It is snowing now	Ahp new-ahp pi-eke.
After, be very cold	Pe-nun-ko tu-ege shu-pe-ki.

Indian numerals.

English.	Ute or Utah.	Shoshonee or Snake.	Pi-Ute.	Washo.	I-at.[7]
1	Shu-ge	Shu-wah	Sur-in	Sac-ka	As-see-to.
2	Wy-in	Wat-too	Wa-ha-you	Has-sla	A-be-ka.
3	Py-in	Pite	Pa-he	Hel-ma	Amo-ko.
4	Whatz-o-win	Wats-so-wit	Wat-se-que	Hah-wha	See-po-po.
5	Man-a-gin	Mah-ne-git	Man-e-ke	To-bal-a-de	Ar-rap-pah.
6	Nah-bah-in	Nah-vite	Na-pa-he	To-bal-do-dal-lau	Ah-seen.
7	Nah-vah-keh-ve	Tah-so-rit	Toc-et-se-gue	To-bal-de-da-bas-ka	Ah-been.
8	Wah-waty-so-vin	Wah-sho-wit	Wo-que-e-gue	To-bal-de-hel-ma	Ah-mo-gue.
9	Show-rump-shin	Shu-wa-ker-ru	Su-me-cot-e-up	Loc-a-lo-le	Pye.
10	Tomb-sho-vin	Sher-wan-it	Su-me-man-a	Loc-a-mo-chum	Hear-a-pye.

[7] The I-at numerals were furnished by Mr. Bean.

Indian numerals—Continued.

English.	Ute or Utah.	Shoshonee or Snake.
11	Shoots-spin-gle	Sher-win-do-in-gin.
12	Wy-in-spin-gle	Wat-te-men-do-in-gin.
13	Py-in-spin-gle	Py-te-to-men-do-in-gin.
20	Wamp-shu-in	Wah-ah-man-it.
21	Ny-in tom-shu-spingle	Wah-ah-man-it-shu-mut-do-in-gin.
22	Ny-in-spingle	Wah-ah-man-it-wat-too-nah-do-in-gin.
30	Pamb-shu-in	Pite-he-man-it.
40	Watz-oo-in-tom-shu-in	Wats-se-won-man-it.
50	Man-e-gin-shu-in	Man-e-gin-man-it.
60	Nah-vam-shu-in	Nah-vah-man-it.
70	Nah-ve-kab-shu-in	Tats-se-won-man-it.
80	Wah-watz-oo-in-tom-shu-in	Wah-she-woon-man-it.
90	Shar-am-shu-in-shu-in-shu-in	She-woon-ne-man-it.
100	Shu-man-tom-shu-in	She-woon-ne-man-it.
1,000	Man-um-tom-shu-in	She-woon-men-do-gin-man-it.

English.	Pi-Ute.	Washo.
11	Su-me-mot-se-po-ke	Tey-yak-loc-a-mo-chum.
12	Wa-ha-mot-se-po-ke	Heska.
13	Pa-he-mot-se-po-ke	Hel-ma.
20	Wa-ha-man-o	Hes-ka-mo-chum.
21	Wa-ha-man-o-su-met-se-wick	Loc-a-te-a.
22	Wa-ha-man-sit se-wick-it	Hes-ka-te-a.
30	Pa-he-man-o	Hel-ma-mo-chum.
40	Wat-se-man-o-e	Hah-wah-mo-chum.
50	Man-e-ke-man-o-e	To-bal-de-mo-chum.
60	Na-pa-e-man-o-e	To-bal-de-dal-coh-mo-mo-chum.
70	Na-toc-se-man-o-e	To bal-de-dal-has-ka-mo-chum.
80	Wo-que-se-que-man-o-e	Ha-wa-wa-mo-chum.
90	Se-ma-cat-a-spa-man-o-e	Loc-i-lo-le-mo-chum.
100	Su-a-man o-nem-ena-a	Loc-a-mo-chum-mo-chum.
1,000	Su-a-man-o-nem-ena-a-len-a	Loc-a-mo-chum-mo-chum-mo-chum.

APPENDIX Q.

JOURNAL

OF

MR. EDWARD M. KERN

OF AN

EXPLORATION OF MARY'S OR HUMBOLDT RIVER, CARSON LAKE,
AND OWENS RIVER AND LAKE,

IN

1845.

APPENDIX Q.

JOURNAL OF MR. EDWARD M. KERN OF AN EXPLORATION OF THE MARY'S OR HUMBOLDT RIVER, CARSON LAKE, AND OWENS RIVER AND LAKE, IN 1845.

WASHINGTON, *September* 10, 1860.

SIR: In compliance with your request for information regarding a portion of the route pursued by the expedition to the Rocky Mountains and California under command of Capt. J. C. Frémont, in the year 1845, I inclose you a copy of my journal, which you are at liberty, if it will be in any way serviceable to you, to make such use of as you may think fit.

Truly, your obedient servant,

EDW. M. KERN.

Capt. J. H. SIMPSON,
U. S. Corps Topographical Engineers.

November 5, 1845.—Whitten's Spring. To-day we parted company, the captain passing to the southward with a small party, to examine that portion of the Great Basin supposed to be a desert, lying between the Sierra Nevada and the Rocky Mountains. The main body of the camp, under the guidance of Mr. Joseph Walker, are to move toward the head of Mary's or Ogden's River, and down that stream to its sink or lake. From thence to Walker's Lake, where we are again to meet. I am to accompany the latter party in charge of the topography, &c. Crossing the mountains near our camp, we arrived about 1 o'clock p. m. at several springs of excellent water. These springs spread into a large marsh, furnishing an abundant supply of good grass for the animals. On the 6th, owing to a severe snow-storm, we were obliged to remain in camp. Having no timber but a few green cedars, fires were not very abundant.

On the 7th we commenced our ascent by a steep and rocky road. The snow was falling lightly when we started, but before we reached the summit, we were nearly blinded by the storm. A short descent brought us into a pleasant valley, well watered by several small streams, and timbered with aspen and cottonwood. This is, really, a beautiful spot, surrounded by high mountains, those on the west covered with snow. Crossing a low range of hills, we entered another valley, that takes its waters from the snowy mountains on either side. The stream, after winding among the grass-covered hills, emerges into a plain, through which we could see Ogden's River flowing. Walker has given this creek the name of Walnut Creek, from one of his trappers having brought into his camp a twig of that tree found near its head; a tree scarcely known so far west as this. Camped on Walnut Creek, having made 14½ miles.

November 8.—At about 6 miles from our camp of last night, we struck Ogden's River. It is about 25 feet wide here and about 2 feet deep, with a tolerable current. Crossing without difficulty, we struck the emigrant wagon-trail. Continuing down it for a few miles, we encamped a little below where the river receives a tributary of considerable size, coming from the northwest. Made to-day about 14 miles.

November 9.—Still on the emigrant trail. This has proved of great assistance to our tired animals; they appear to have new life. Met to-day several Sho-sho-nee Indians, who report three separate parties of emigrants having passed this fall. About four miles above our camp of to-night are some hot springs, too hot to bear one's hand in. Walnut Creek empties into the river about 1½ miles below our camp. Made 19 miles.

November 10.—Crossed the river several times. At one point, the high, rocky ridges that bound the bottom came so close to the banks of the river, we were obliged to pass in the water. The timber is principally cottonwood.

November 11.—We left the river to avoid a bend it makes. Ascending some grassy hills, encamped at several springs. Bunch-grass plenty; 11 miles.

November 12.—Continued among the hills for about five miles, when we again struck the river. The country is becoming more open. The hills on the right make a wide sweep from the river, returning to it again at our camp of this evening, November 13. On the left bank the mountains are close and high and rugged in their character. Near our camp on this bank they make a bend forming a valley, through which one would suppose the river to flow. The character of the rocks is changing; more bold, basaltic.

The river presents but little variety, always the same winding, crooked stream. On the 23d November, we arrived at the sink or lake. This lake is about 8 miles long by 2 in width; it is marshy, overgrown with bulrushes, at the upper end. On the eastern side is a range of low hills at the upper, and increasing in height at the lower end of the lake. On the western side is a level plain of clay mixed with sand. The country here becomes more desolate in its appearance. We have been fifteen days on this river, making a distance of nearly 200 miles. The grass has been generally good. The only timber is a few cottonwood trees and willows; the latter are in great abundance on its banks, though very small. The river-bottoms vary from 4 to 20 miles in width. Vegetation failing as we approach the sink, the soil becoming more sandy and sterile. The Indians we first met were better clad than one would suppose; having also a few horses among them. As we approached the sink, however, they appeared much more indigent and shy, hiding from us on our approach; raising smokes and other signs of warning to their friends of the approach of strangers. They belong to the Bannack tribe of Diggers, and are generally badly disposed toward the whites. Walker was attacked some two years since by a party of them numbering, he thought, near 600; these he defeated without loss to his own party. The loss on the part of the Indians numbered 16. Walker was engaged at that time exploring for a route into California, through the Sierra Nevada.

A curious feature of this river is the number of small streams near its banks and immediately in its bed. We tried the temperature of one on the 10th instant with a thermometer graduated to 160°, to which point the mercury rose in a few seconds. From its situation, forming as it does a long line of travel of the emigrant parties, this river will soon become an interesting and noted point in this now great wilderness. Portions of its immediate bottoms may be capable of cultivation; but the bare, sandy bluffs that surround or border it, produce little save bunch-grass, and no timber. Great numbers of ducks and geese are to be found in this region. A small gray duck is of excellent flavor. Provisions becoming scarce. Leaving our camp of the 24th November, on the outlet of the lake, we crossed a low, gravelly ridge, mixed with heavy sand, for 4 or 5 miles; we then struck a level plain resembling the dry bed of a lake, extending to a low range of hills on the western side 10 or 12 miles distant, and from 20 to 25 miles on the eastern side, running in a northeasterly direction, and continuing east of Ogden's or Mary's Lake, probably connecting with some of the high ranges visible from the river on the 18th and 19th. As on the plains on the western side of the Great Salt Lake, the incrustation yielded to the tread of our horses. Nothing can appear worse than the surrounding country; the glare of the white sand, relieved only by the rugged distant mountains, the absence of animal and vegetable life, make up a whole in the way of dreariness and desolation.

The outlet of Ogden's Lake, after running several miles toward the rim of this basin, forms a large marsh in the midst of the sand-hills. Our animals failing, we encamped among the sand-hills, without grass or water.

November 25.—A couple of hours' ride this morning brought us to the outlet of another lake, where we encamped, having ridden twenty-five miles. The water in this stream is running, but is indifferently good. The banks are from 8 to 10 feet high; growth willow. Sand-hills on either side. On the east runs a low rocky range, beyond which are ridges and peaks of higher mountains. About eight miles below us this stream forms a large marsh, hidden from us by sand-hills. Walker tells me that its waters are extremely disagreeable. I found skulls of the natives killed here by Walker's party some ten years since. The emigrants turn toward the California Mountains from the sink of Ogden's River. After a noon halt and rest to our animals, we crossed and continued down the river, camping near the lake.

November 26.—In a southeasterly direction nine miles along the border of the lake. For 30 or 40 yards about its edge in width is a thick growth of bulrushes. It is a very pretty sheet of water; various kinds of fowl in abundance. The greatest length is about 11 miles. On the eastern side runs a low range of burnt rock hills. The lake is bounded on the west by a low range of mountains; about midway on the western side a stream enters it. Slightly timbered; probably cottonwood.

November 27.—In a southern course, over a level for about 3 miles, then crossing a low ridge of sand and burnt rock down an open ravine, leading into a larger plain, we made camp among the sand-hills, at some Indian wells of bad water, thoroughly impregnated with sulphur. These wells, with a little trouble, could be made a good watering-place; but, as they now are, it was with the greatest difficulty that we could procure a sufficiency for our animals. There was plenty of good bunch-grass about camp; no fuel but greasewood. Continuing our route over low, heavy sand-hills, we rejoined Captain Frémont at our place of rendezvous, Walker's Lake. He had reached that point four days ahead of us, having traveled over a mountainous country, finding in his route plenty of grass, water, game, and Indians; the latter very shy, not being accustomed to the sight of white men in their desolate country. The river of Walker's Lake is a fine, bold stream, 30 to 40 feet wide, with considerable current, timbered with fine large cottonwoods, its bottoms covered with a luxuriant growth of grass, wild peas, and rushes. We had anticipated a glorious feast of fish on our arrival at this point, from the glowing descriptions Walker had given us of great quantities of fine salmon-trout which frequent the river and lake. In this, however, we were doomed to disappointment. The fishing season being over, "Carro hoggi" was the only reply we could obtain to our many signs and inquiries after the finny tribe from the few Indians that still lingered about the lake.

To-morrow (November 29) Captain Frémont leaves us again, this time to take his old trail of 1843, while the main body of camp will continue down the eastern slope of the Sierra Nevada, which Walker had discovered when exploring this section of the country some 10 years ago. We will remain here 9 or 10 days to recruit our animals, as many of them are exhausted.

December 8.—Once more took up our line of march. During our stay at our camp on Walker's River the weather has been clear and cold. Thermometer at sunset 23° above zero, and at sunrise 4°. The river frozen hard; it has been a strange mixture of winter and summer. The Indians are of a much lower grade than any I have yet seen. They are, however, very friendly. I visited some of their huts near the mouth of the river. They had some very pretty decoy-ducks, made from the skin of those birds, neatly stretched over a bulrush float. There were four or five old women hovering over a fire of a few willow twigs of six or eight inches in length. I thought if the personification of witches ever existed, these were of them. Their withered bodies, almost entirely naked and emaciated, their faces smeared with dirt and tar, the dull, idiotic stare of their eyes, trembling from cold and dread of our intentions toward them, rendered them to me the most pitiable objects I had ever seen. A couple of children, nestling close to the fire, showed more the signs of wonder in their countenances than fear. Some of these children, notwithstanding the hardships of their lives, only dependent on grass-seeds and the few fish they can catch, any large game being unknown hereabouts, have really lively and interesting countenances; but the expression leaves them with youth; their future, being one of continued privation, soon dulls the light of the eye, and the face becomes heavy and stolid in expression. It was at this camp we have made our first essay on horse-meat. Throwing aside all antipathies I, with the others, enjoyed our meal. On this river, with but a couple of exceptions, is the only *large* timber we have met since leaving the Timpanogos. Traveling three miles on the river and about twelve on the shores of the lake, we made our camp among some low sand-hills. A range of burnt rock hills extends a few miles further back, while on the opposite side of the lake the dark mountains come bluff to the water's edge. No fuel but greasewood and grass. We longed heartily for the fires of our last ten-days' camp, the weather being excessively cold.

December 9.—Camped near the head of the lake. No grass; the water exceedingly bad and salty. Charley, (our cook,) to improve (?) the already horrid taste given to our coffee by the bad water, added some greasewood or other noxious weed, giving it a flavor too unsavory even for appetites as keen-set as ours. This lake is about twenty-two miles in length, and eleven or twelve in the widest part. To the eastward of our camp runs a valley. About twelve miles down it Walker says he found springs of good water and an abundance of good grass, the springs forming a small lake. To-night the horses, driven to desperation by their bad fare, a large number of them eluding the vigilance of the guard escaped to the other side of the lake, where they were found in the morning, having discovered somewhat better grass than we had at our camp.

December 10.—Leaving camp we traveled up a valley leading from the southern end of Walker's Lake, a little east of south; at about eight miles we crossed a low ridge, heavy sand and scattering bunch-grass. Traveling up the general direction of a ravine, in a southeasterly course for about six miles, we made camp late at some springs near the foot of a basaltic rock ridge.

December 11.—Continued our route down the valley in a southerly direction. Walker's trail of two years ago passed to the left of our camp three or four miles. Passed several wells dug by the Indians, but they were dry. Also, a large corral or pen made of sage and cedars for the purpose of ensnaring deer. Continued about six miles into the mountains by a rough and broken road. Were unable to find water. In the evening we encamped among some of the largest sage I have ever seen. This gave us an abundance of fuel, and also served us in constructing pens about our different camp-fires as a protection from the cold. We soon forgot in slumber our lack of water Here we killed our last beef, if what was left of the animal could be dignified by such a name.

December 12.—To-day we obtained a fine view of the great Sierra Nevada from the far north till it faded on the distant horizon far to the south of us. This bold and rocky barrier, with its rugged peaks, separates us from the valley of California. We are to travel along its base till by its lessening height it will offer but a slight obstacle to our passage across it. To the southeast and east of us mountain rises beyond mountain as far as the eye can see. Descending by a break-neck road we reached, toward evening, a small valley, where we made camp. We found a portion of the sand leveled very smooth and some willow hoops lying about, with fresh signs to convince us that the place had not long been vacated by a party of Indians.

December 13.—Still among the burnt rock hills, interspersed with grassy valleys. Descending into a large, open, grassy valley, we fed upon the dry bed of a stream that has both wood and water six or seven miles farther up. Camped at a large spring that spreads into a marsh.

December 14.—Traveled down the same valley. Water rises and sinks, breaking through a rocky ridge to the east; rising again in several cold springs at the entrance of the gap, runs a short distance and forms a stinking lake. Crossing the ridge by an Indian trail, we came into another valley watered by a fine warm stream, in which I took a delightful bath. Good grass and plenty—quite a treat for our tired animals.

The boys brought in some roots they had found near a couple of Indian huts, the inmates having fled at their approach. The root was of some water-plant of good flavor. They were plaited together in ropes, something after the manner of doing up onions at home. Our old cook at fault again to-day, boiling a large piece of rosin soap in our coffee. Rather unlucky just now, when coffee is coffee.

December 15.—The same water of yesterday still finds its way into another valley more to the east. We crossed into this. Its greatest length is from north to south. On the eastern side is a high chain of mountains, about the height of those on eastern side of Utah Lake. The mountains throw out some small streams, which sink before they fairly reach the valley. The road in the forenoon of to-day broken and sandy. We have gained four days on Walker's route of 1843, from camp of December 10 to this place. A better route lies to the right of our road.

December 16.—To-day struck Owen's River. It is a fine, bold stream, larger than Walker's. The same chain of mountains bounds it on the east, while on the western side rises, like a wall, the main chain of the California Mountains. Our rations are becoming extremely scant. The men being all on foot, they feel their appetites much quickened by the additional exercise of walking. A few more days we hope will bring us to the land of plenty.

December 17 and 18.—Still on the river; obliged to keep some distance from it on account of a large marsh. Wild-fowl in abundance. Walker went in search of some salt, which he found, incrusted to the thickness of a quarter of an inch on the surface of the earth. The Indians are numerous here, though they keep out of our sight. They are badly disposed. Colonel Childs had trouble with them here. They shot one of his men. Walker's party killed some twenty-five of them, while on his side some of his men were wounded and eight or nine horses killed.

December 19.—Camped on lake near the mouth of river. Grass poor Ducks and geese plentiful.

December 20. Traveling down the lake. Main California Mountains close on our right within half a mile of us. This lake is somewhat irregular in its shape, lying north and south; is about fifteen miles long, the widest part about seven miles. On the western side there are several capes. It is surrounded by high mountains. Water strong, disagreeable, salty, nauseous taste. There are Indian fires among the rocks within half a mile of us. None ventured nearer. They appear to be well supplied with horses, judging from the quantity of sign. Along the route of to-day we crossed several streams coming from the mountains, some of them dry; all slightly timbered with cottonwood.

December 21.—Leaving lower end of lake, we passed among some sandy hollows, falling into a larger ravine leading south. Passing a good camp for grass and water, the hollow narrowed, bounded by hills of minutely broken black rock, opening afterward into a large plain; camped at some springs on the slope of the main California Mountains; grass, fresh and green, owing to the late rains. To-day we met for the first time the yuca tree, nicknamed by the men "Jeremiah," in lieu of some better title. These trees have a grotesque appearance, a straight trunk, guarded about its base by long bayonet-shaped leaves; its irregular and fantastically shaped limbs give to it the appearance of an ancient candelabra. It bears a beautiful white flower. We passed to-day Child's caché, where, on account of his animals failing, he was obliged to bury the contents of his wagons, among which was a complete set of mill-irons.

December 22.—Passed to-day a salt-lake, half a mile long and about 200 yards wide; leaving this, we turned up a large hollow, for about four miles, to find a camp. At this point there may be a pass over the mountains, judging from the number of Indian trails joining together here. The ascent, however, is very steep, and it was judged advisable not to attempt it, our animals not being in a condition to undergo any such experiments. So we continued our route in a southerly direction, among the foot-hills of the mountains.

December 23 *and* 24.—Still among the hills. On the 23d, a mule was lost, with its pack. Archambeau, Stradspeth, and White were sent back in search of it; returned on the evening of the 24th, with the animal. The mule was loaded with, to us, a very valuable cargo, sugar and coffee, with some of the "possibles," of Stradspeth and White. The mule had wandered up one of the many ravines in the hillsides. When the Indians were discovered, they were sitting very coolly among the rocks, where they had driven the mule, dividing the spoils; there were three of them. Of the sugar they had made a just division, but the coffee was to them perfectly useless. They had already charred and pounded it, without coming to any satisfactory conclusion as to its use. The "possibles" shared the same fate as the eatables. Among the articles a blanket and an overcoat. Being three in their party, and being unable to divide these things equally in any other way, one had taken the blanket, and tearing the coat in two, gave a half of it to each of the others. On our men showing themselves, they fled precipitately, leaving the property behind. Collecting and re-arranging the pack, the men started for camp, bringing with them, as proof of their victory, some bows and arrows, a large sack of sage-seed, about as digestible as sand, and a small sack of some compound, which we could not make out; it was very palatable with coffee, of a dark chocolate color.*

Our Christmas was spent in a most unchristmas-like manner. Our camp was made on the slope of the mountain, at some Indian wells of good water. The yuca tree is here in great abundance, furnishing us a plentiful supply of fuel. The camp-fires blazed and cracked joyously, the only merry things about us, and all that had any resemblance to that merry time at home. The animals, on account of grass, were guarded about a quarter of a mile from camp, higher up the mountain.

December 25.—Christmas day opened clear and warm. We made our camp to-day at some springs among the rocks; but little grass for our animals. Dined to-day, by way of a change, on one of our tired, worn mules, instead of a horse.

Turning from our camp of the 25th into the mountain by an easy ascent, and over a somewhat broken road, arriving on the 27th, on the head-waters of a river.† Continuing down this stream, on the 28th we made camp at its forks. This is the appointed place of rendezvous. There are no signs yet of the Captain. Our provisions have entirely failed; save the few remaining horses of our cavallada, there was not much prospect of obtaining fresh supplies. To have killed these would have been to deprive us of the means of transportation of our effects and the results of the expedition, in case we are not joined by Captain Frémont in this place. A party of Indians visited our camp, from whom we traded a colt. The hunters brought in a few small deer, the meat extremely poor. A small piece of vension, with as much cold water as one could drink, furnished breakfast, dinner, and supper in one. We became reduced to acorns, and on this swinish food made our New-Year's feast. This forms the principal food of the natives, here and in the valley. Our camp is situated in a beautiful valley, about six miles in length, and well-timbered with pine, cedars, and cottonwood, while the mountains which surround it are of the usual growth of the Sierra, the majestic redwood, &c. The river is a bold stream, coming from the northeast. The Indians inhabiting this region are of the most degraded class, entirely naked, and with scarcely a sufficiency of food to sustain life. I was amused at coming suddenly on a half a dozen of these characters; being armed, they, probably having a dread of pistols, immediately commenced crossing themselves in the most devout manner, at the same time muttering "Christiano, Christiano," the probable extent of their Spanish, hoping to avert any evil intent we might have had toward them.

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*I have seen the same dish among the Indians of California; it is prepared from roasted grasshoppers and large crickets, pounded up, and mixed with, when procurable, some kind of animal grease.

†Now called Kern River.

Since leaving Walker's Lake we have traveled through a country having a few pretty spots, but for the most part a sandy waste, broken by short chains and isolated mountains. Bunch-grass is found among most of the sand-hills. Water, save in the rivers, is not to be had in anything like a sufficiency. Piñon and willow are the principal timbers. From our camp of December 26, toward the south, as far as the eye could reach, lay a continued plain of sand, relieved only by an occasional hill of burnt rock rearing itself above the level, adding, if possible, to the desolation of the scene, with no game, save now and then a hare, and perchance a stray goat. Lizards are here in abundance, and form the principal food of the hungry natives. At our camp the weather has been extremely fine, warm, and sunshine. On the 13th of January there was a severe storm of snow and sleet; a shower followed that soon removed all appearance of winter from the valley, but the mountains retained this, their first winter covering.

January 18, 1846.—Raised camp and traveled about five miles into the mountains, stopping for the night at the hunter's camp, in a pretty valley; snow about two feet deep. An abundance of the most beautiful timber, live-oak, pine, redwood, &c.

January 19.—To-day we reached the summit; snow 2½ feet deep. From here we had the first view of the much-wished-for Valley of California. It lay beneath us, bright in the sunshine, gay and green, while about us everything was clothed in the chilly garb of winter.

On the 21*st January* we reached the valley; our descent was rough and broken; the mountain well watered and densely timbered. Among the foot-hills are beautiful groves of live and other oaks, clear from growth of underwood; the fine grass gives the country the appearance of a well-kept park. We passed two Indian villages; the huts were built of tulé or bulrush. The men entirely naked; the only covering the women possessed was a kind of petticoat made of tulé. The country is much cut up by gullies. The weather is warm like spring, the young grass and some few flowers just putting forth. Notice a small blue flower particularly very abundant.

Crossing several small streams that find their way into the great Tulare Lake, we encamped, on the evening of the 26th of January, on a fine bold stream.* The whole country is well watered, and capable of high cultivation. Oaks and willows in abundance. The river† heads in the Sierra Nevada, running in a west, a little south, and then in a southerly direction. Walker thinking to make a cut-off at the bend, we were obliged to spend a most uncomfortable night at some holes of water, amid a storm of cold rain, with no fuel save a few willows.

January 28.—After searching in vain for the river, we camped, at 9 o'clock at night, among the foot-hills of the Coast range, without grass, water, or fire, having traveled through immense fields of old tulé, the horses sinking at almost every step as deep as their bellies; having to be hauled out only to sink again, owing to the loose rotten soil. This has been the most tedious day we have had since we entered the valley, and particularly trying to our animals in their present weak state. Cloudy and rainy all day.

January 29.—Leaving our miserable camp of last night early this morning, we struck a northerly course, passing a large dry creek timbered with cottonwood, over a plain destitute of vegetation (the grass and shrubbery having been destroyed by the wild horses), we made camp on a large slough.‡ Manuel, to-day, killed a fat wild horse—as acceptable a thing as could have happened, as we were out of meat, and had been so for two days.

January 30.—Continuing down the slough for four or five miles, we struck a bold stream—the San Joaquin. It is heavily timbered with oak and willow. Wild horses and elk begin to show themselves.

February 1.—Jim Connor and Wetowa (two Delawares) tracked a large grizzly bear to his thicket. The whole camp prepared themselves for the attack: after much difficulty, he was killed. This animal was one of the largest size; he must have weighed at least 900 pounds. This acquisition to our larder enlivened the spirits of the men, and mirth abounded at the various camp-fires that night; the song and joke, the accompaniments of plenty in the wilderness, could be heard everywhere.

Continuing up the valley toward Suter's fort, on the 6th we arrived and made camp on the Calaveras, a tributary of the San Joaquin. Messrs. Fabbol and Walker started on ahead to hear if they could obtain any tidings of Captain Frémont. They returned again in the evening in company with Big Fallen, an old mountaineer, known more commonly by the sobriquet of "Le Gros." From him we learned that the captain was at the pueblo of San José with the rest of his camp. The next morning Fallen and Walker started for the pueblo to give him intelligence of our whereabouts, while we would return to the crossing of the San Joaquin to await further orders. Yesterday Jim Secondi (a Delaware) killed another bear, the counterpart of the one killed on the 1st instant.

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* The Rio Reyes, or Lake Fork.

† Walker mistook this river for the South Fork of the San Joaquin.

‡ This slough, at high water, connects the waters of the San Joaquin with the great Tulare Lake.

February 11.—To-day we were joined by Carson and Owens, at the crossing. Crossing the river in boats or rafts, made of tulé.

February 15.—To-day we met a party of the boys with fresh horses, sent out to meet us. We passed through the pueblo of San José. The country between the pueblo and the Calaveras is beautiful, and well suited for cultivation; the streams are well timbered with different species of oaks. The flowering season is commencing, adding great beauty to the plains, by their variegated colors. The mission of San José is about twelve miles from the town, situated at the foot of a mountain, on the road from the crossing of the San Joaquin. It was formerly one of the richest missions in the upper country; it presents now but a poor appearance, and shows the evil resulting from the removal of the padres, whose posts were replaced by rapacious "administradors" of government. The building is very large and built of adobes; the roof is of tiles. Long rows of adobe buildings, one story high, used as the dwellings of the native converts, are now in a most dilapidated condition, scarcely affording shelter for the few miserable Indians who still cling to those hearths, where they had been raised, by the kindness of the founders, to something like civilization. The remains of the gardens and vineyards show the care and labor bestowed on the grounds by the fathers. Opposite to the mission, on an eminence, is the Campo Santro; the entrance to it is surmounted by a large cross. From here we can see an arm of the bay of San Francisco. The pueblo of San José is a small town of some 50 or 60 houses, most of them in a very crumbling condition, showing the slothful habits of the people. We arrived about noon at the "Laguna farm," where we rejoined Captain Frémont, who was anxiously awaiting our arrival. Both parties were again united, without any serious accident having happened to either, and both had had their share of hard times.

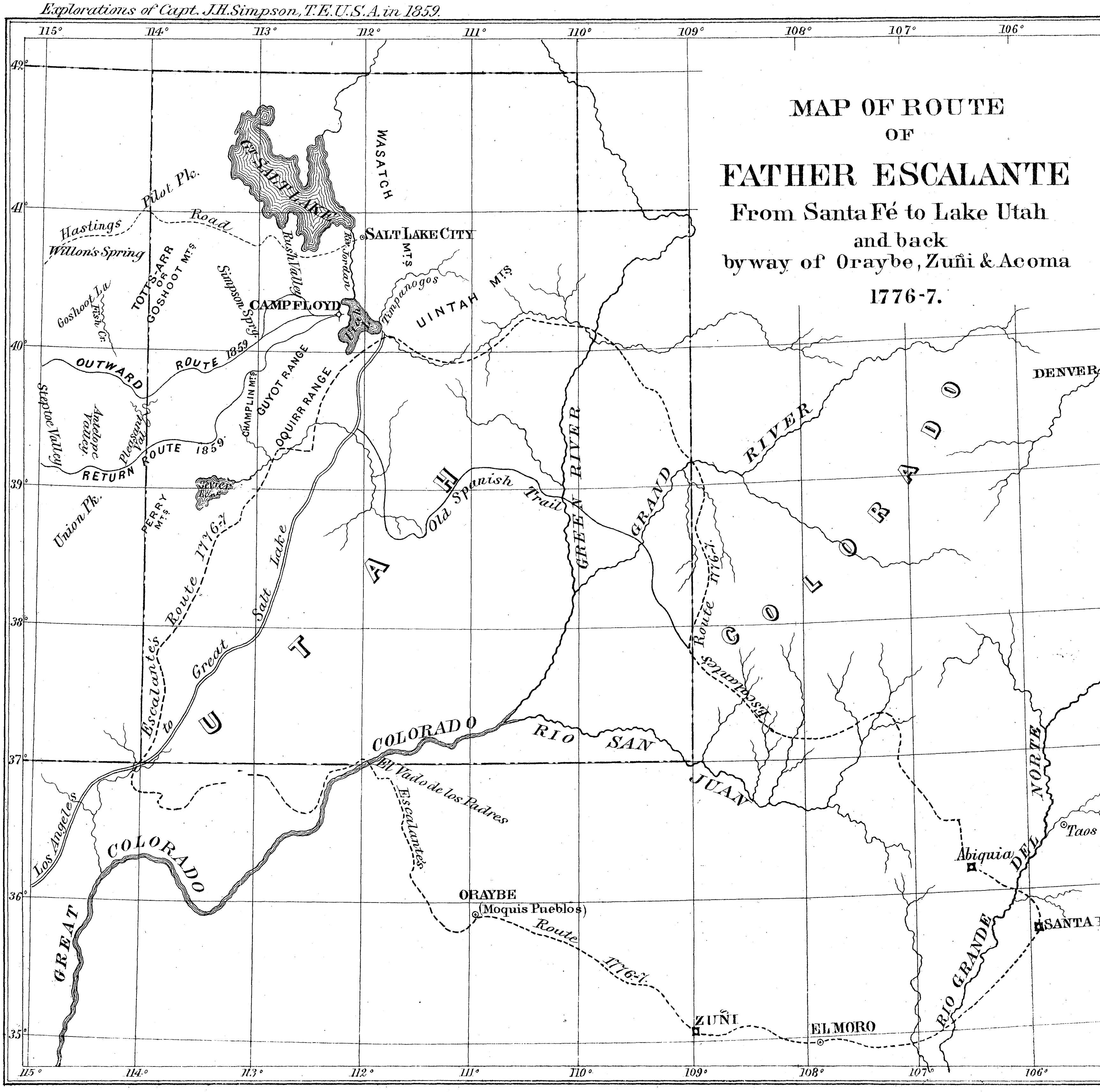
NOTE.—When separating from Captain F. on Walker's Lake, Walker had given a description of the valley of California, where a river which he *supposed* to be the Rio Reyes (and on which we encamped from the 27th of December till the 18th of January, 1846, the same which is now called Kern's River), enters the valley, the description and the rude map which I made from it, answered to the markings of the country very well. Supposing we had entered the valley at the river Reyes, we crossed the several small streams that find their way into the Tulare Lake, and when reaching the Lake Fork or Rio Reyes, he (Walker) fancied himself on the South Fork of San Joaquin. I remember Walker's telling me that the river made a great bend to the southward, and to make a cut-off, we left its banks, and in expectation of again meeting it, traveled till we found ourselves climbing the Coast range. Walker had fallen into the error on a previous trip years ago, and had, in search of the river, crossed the Coast range toward Monterey. On his return trip he left the country by a more southern pass in the Sierra, which Captain Frémont calls Walker's pass. Walker's old pass was to the northward of this by what is now called Kern River. The mistake Walker made in the name of the river on which we had camped to wait for Captain Frémont was the cause of his failure to make a junction with us, as had been prearranged, at Walker's Lake; Captain Frémont, as will be found by his memoir of 1848, having ascended the Rio Reyes (proper) in search of our party.

E. M. K.

APPENDIX R.

JOURNEYINGS
OF
# FATHER ESCALANTE,
FROM
SANTA FÉ TO UTAH LAKE AND THE MOQUI VILLAGES IN 1776.
BY
PHILIP HARRY.

Explorations of Capt. J.H. Simpson, T.E. U.S.A. in 1859.



MAP OF ROUTE
OF
FATHER ESCALANTE
From Santa Fé to Lake Utah
and back
by way of Oraybe, Zuñi & Acoma
1776-7.

APPENDIX R.

THE JOURNEYINGS OF FATHER ESCALANTE, FROM SANTA FÉ TO UTAH LAKE AND THE MOQUI VILLAGES, IN 1776.

By Philip Harry. 1860.

The original manuscript journal of Padre Escalante is said to be in the archives of the city of Mexico. A manuscript copy is in the possession of Peter Force, esq., of Washington, D. C., to whom I am indebted for the inspection and use of it. Below is a summary of the narrative.

On the 29th of July, 1776, F. Francisco Atanacio Dominguez and F. Francisco Silvestre Velez Escalante, accompanied by seven or more other persons, left Santa Fé, N. Mex., crossed the Rio del Norte at the pueblo of Santa Clara, and followed, by way of Abiquiu and the Rio Chama, what is now known as the "Spanish Trail." This is the great route from Santa Fé to Los Angeles, Cal., &c.

I have not had time to translate his journal, and plot in detail his route from Santa Fé to where he struck the Rio Dolores, but have examined it sufficiently to satisfy myself that he followed almost exactly the same route that Capt. J. N. Macomb, Topographical Engineers, lately traveled over, and which the latter has surveyed and mapped. Up to this point on the Rio Dolores, both Escalante and Captain Macomb were on, or at least close to, the "Spanish Trail," crossing the Rios Navajo, San Juan, las Piedras, Florido, Las Animas, La Plata, Los Mancos, &c., at or near the same places.

The point above alluded to on the Rio Dolores is so remarkable that there can be no question of its identity. The river rises in the Sierra la Plata, and flows southwesterly until it reaches this point, whence it makes a sudden bend at a very acute angle, and runs in a direction not many degrees west of north until it falls into Grand River. At the sudden bend above mentioned there are also some extensive and interesting ruins of an ancient Indian pueblo, which are pointedly adverted to both by Escalante and Captain Macomb. Here the routes of Escalante and of Captain Macomb diverge, and Escalante follows the Dolores for many leagues down stream. Then leaving it and going northeasterly, he comes upon a small stream, which he calls the San Pedro, and which falls into the Dolores a few leagues to the westward; he follows it up stream for a short distance, and then taking a still more easterly course gets on to the Rio Francisco (so called by him), a considerable affluent of the San Xavier (Grand River), and which enters the latter some ten leagues to the north. He follows the right bank of the San Francisco, but leaves it before he reaches its mouth, and arrives at the Rio de San Xavier, which is evidently what we call Grand River. Escalante states that the Yutas call it "Tomiche," and he also says that, in the year 1765, Don Juan Maria de Ribera came to the San Xavier at a point a little below the junction with the San Francisco.

He describes the San Xavier as being formed by four smaller rivers or forks (of course he means above his crossing-place), and this corresponds remarkably with the Uncompagre River, Grand River, Smith's Fork, and another large fork, all of which are represented on our maps as coming together a short distance above Escalante's supposed crossing It seems evident that, after crossing the San Xavier, he follows up stream a different fork from what we call Grand River, but which fork he considers the main river, or San Xavier. The mouth of this fork is indicated on the map of Captain Gunnison's explorations. After having followed this fork for many leagues a little east of north, Escalante comes upon a large "rancheria" of Indians, and procured from them a couple of guides. Hence he travels northwesterly until he arrives at the San Rafael, quite a large river This is clearly the Blue River of our maps, the main fork of Grand River, and which ought, therefore, to have been so called, instead of the smaller and more southerly branch which goes by that name. He fords the San Rafael at a place where it separates into two branches (probably forming an island), and in other respects describes the locality in such a manner that it might easily be recognized by a person acquainted with the river. From the San Rafael to the San Clemente (now called White River) his course is about northwesterly, and thence nearly west to the Rio de San Buenaventura, which he crosses at a very remarkable ford. This, together with its neighboring landmarks, he describes most minutely. The San Buenaventura of Escalante is evidently Green River, and he strikes it in about latitude 40° 19′, and some 12 or 15 leagues above the mouth of White River, coming from the eastward, and the Uintah River from the westward. He travels down the right bank of the San Buenaventura to within a short distance of the mouth of the Uintah (which he calls Rio de San Cosme), and then strikes westwardly over to the latter, and follows its northern bank until he crosses what is now called Duchesne Fork.

After leaving this, and making his way with great labor westwardly through the Wahsatch Mountains (to which Escalante does not give any particular name), he descends into the more level country at the southern end of Lake Utah, and goes to that lake which he says the Indians call "Timpanogo."

Of this lake and its vicinity he gives a very particular description. He speaks of the rivers that enter it, and of its connection by a narrow outlet with a much larger lake, or body of lakes, to the northward, which are *very salt*, &c.; but this large body of salt water he did not visit.

After spending a few days among the Lake Indians, or "Timpanogotzis," Escalante bends his steps southerly and comes to the Sevier River, which he calls Santa Isabel. He then travels westerly some fifteen or more leagues, in the salt plain through which the river runs, and then leaves it in order to follow a southerly course again, and without coming upon the salt lake or marsh, which he is told that it enters, and subsequently leaves to run westwardly.

By many it has been supposed that Escalante called this river the San Buenaventura, and, moreover, that he asserted it to flow into the Pacific Ocean. I have not seen Escalante's map (if he constructed any), but his journal merely states that, judging from the name which the Indians give this river, and from the manner in which his guide spoke of it, one might be led to suppose that it was the same river as the San Buenaventura, which he crossed further eastward (and, as above stated, in about latitude 40° 19′); but he goes on to say, we could not believe this to be the case, because there was so much less water in the Santa Isabel than in the San Buenaventura where we crossed the latter, besides which the San Buenaventura is joined by many affluents, such as the San Clemente, the San Cosme, the San Damian, and many smaller rivers below the aforesaid crossing place (all of which would increase immensely the volume of water before it could reach the point where Escalante struck the Santa Isabel). So far from his saying that the Santa Isabel debouches into the Pacific, he merely once states, on hearsay, that it enters a salt lake and emerges from it to run westwardly.

His course is now southerly along plains and good traveling-ground until he gets into about latitude 38° 40′. Here, for the first time, he alludes to the fact that the original intention of the party was to reach Monterey, Cal., but that, in consequence of the lateness of the season (it was the 7th of October) and the increasing coldness and inclemency of the weather, he judges it impossible to reach Monterey before the winter sets in with great severity and exposes them to perish by cold and starvation. He therefore persuades his companions to abandon the idea of traveling to the Pacific, and to make the best of their way, by some route hitherto unexplored, to the Moqui villages, and thence back to Santa Fé. In pursuance of this plan he continues southerly, passing the spring of San José (which is probably the same that is so called at this day, and which is near Paravan), and soon after gets upon a small river which he calls the Rio del Pilar (most likely the Santa Clara of Frémont and others). This he follows for some fifteen or twenty leagues and then leaves it, running southwesterly. Continuing on his southerly course he gradually gets as far down as about latitude 36° 20′, meeting occasionally with Indians, who sometimes mislead him and sometimes give him useful, though confused, information respecting the distance of the Colorado River, and the direction in which to find a ford. After traveling a very circuitous route (and living on the meager fare procured from the Indians, for the provisions of the party were entirely exhausted), first southeast, then north, then northeast, then southeast, he gets into the immediate vicinity of the tremendous cañons which inclose and radiate from the Colorado. He now follows up stream, the direction of the river's course, searching for a ford. This course is here north and then northeast. Twice he gets down to the river and tries to cross it, but without success; but, finally, after great labor and fatigue, climbing up and down the almost impracticable cañons and cliffs, and being compelled to kill several horses for food, he finds the ford and crosses the river on the 8th of November, in about latitude 37°, and somewhere between longitude 111° and 112° from Greenwich. With the exception of still having to kill and eat their horses, the hardships of the party are now nearly over. From the ford they ascend along a cañon to the high table-land and find good trails all the way to the Moqui villages, where their wants are relieved. Hence they have no further trouble in reaching Zuni (where there is a mission) and then Santa Fé, by way of Acoma, on the 2d January, 1777.

It may be interesting to know that Escalante found the Moquis opposed to Christianity, which had at one time been introduced among them, but from which they had apostatized. He had some lengthy interviews with their headmen, and tried to persuade them to return to the fold, and to submit to the Spanish government; but although they displayed no hostility, and, on the contrary, were quite friendly and hospitable, they did not show any disposition to come to Escalante's terms, any further than in what might be advantageous to both parties in the way of trade.

On his outward journey to Lake Utah, and again, when he is homeward bound, but still to the westward of the Colorado, Escalante inquires of the Indians whom he meets whether they have heard of any padres (meaning the Padre Garces), or of any Spanish, coming from Monterey to the Moqui villages; but the Indians either know nothing, or are unwilling to say anything about the matter. After crossing the Colorado he does not allude to the subject any more, and the reason for this seems to be, from certain remarks that he makes, that the Moquis were displeased with the Cosninas, their neighbors to the westward, for having brought to them (or allowed to pass through their country) the Padre Garces. It became therefore useless and impolitic for Escalante to say anything about his brother padre, from Monterey, after he had crossed the Colorado, and was in the vicinity of the Moquis.

All this settles the point, it appears to me, that the expedition of Garces to the Moquis had taken place previous to that of Escalante, and that the latter knew of it. Humboldt states that the expedition of Garces was in 1773. So far as we know, and as indicated on a copy of a map that was found in the archives of New Mexico, Garces did not go further eastward than Moqui, but returned to California. The copy of the map above mentioned is in the Bureau of Topographical Engineers, and is dated 1777.

Escalante's journal is written with great precision and clearness, every day's courses and distances are stated, the topographical features minutely described, and a good deal of mineral and botanical information added.

The two padres, Dominguez and Escalante, went on a pacific mission of discovery and propagation of Christianity among the Indians; their companions were evidently actuated solely by worldly motives. It was with great difficulty that Escalante and his brother padre could prevail on the rest of the party to give up the idea of going on to Monterey. They had undoubtedly been considering this—the exploration of a route through to the Pacific coast—as the main object of the expedition, and looked forward to this route as a source of great future advantage and lucrative speculation.

As a matter of special interest I have subjoined a literal translation of Escalante's description of Lake Utah or "Timpanogo."

"At the northern part of the river San Buenaventura there is a range of mountains, which, according to what we ascertained yesterday, extends from the north to the southwest more than sixty leagues, and which in breadth is at most forty; where we crossed it, it is thirty. In this range, and in the westerly portion of it, and in lat. 40° 49′ (*a*), in a direction northwest quarter north (north $33\frac{3}{4}^\circ$ west) from the town of Santa Fé, is the valley of our Lady of Mercy of Timponocnitzis, surrounded by the crests of mountains, whence issue four middle-sized rivers, which water it until they enter the lake, which lies in the middle thereof.

"The area of the valley is in extent from southeast to northwest (*b*) 16 Spanish leagues, which are what we speak of in this journal, and from north to southwest, 10 or 12. It is level, and, with the exception of the marshes, which are found on the margin of the lake, is of a very good quality of soil for every kind of grain. Of the four rivers that irrigate it, the first or most southerly is that of Hot Springs (*Rio de Aquas Calientes*), and, in its wide-spreading meadows, there is sufficient irrigable land for two good settlements (*poblaciones*); the second, at three leagues north of the first one, and having more water, might support a good large 'poblacion,' or two middle-sized ones, with an abundance of land, all open to irrigation. This river, before it enters the lake, divides into two branches; on its banks, besides cottonwood trees, there are large alders. We called it the Rio de San Nicolas. Three leagues and a half to the northwest of this comes the third, and the intervening space is composed of flat meadow-land, the soil of which is good for grain-crops. It is more copious than the two preceding streams, has larger groves of cottonwood, and meadows of good soil, with enough of it irrigable to support two, or even three, good 'poblaciones.' We were in its neighborhood on the 24th and 25th of September, and we named it 'Rio de San Antonio de Padua.' We did not visit the fourth river, though we saw its cottonwood groves. It is to the northwest of the San Antonio, and there is in this direction much level land, and, so far as we saw, good; and, therefore, several 'poblaciones' might be established there. They told us that this stream had as much water in it as the others. We called it the Rio de Santa Aña (*c*). Besides these rivers, there are in the valley many good springs of water, and numerous streamlets that come down from the mountains. What we have just said about the settlements (*poblaciones*) is to be understood as allowing to each one more land than would be absolutely necessary for it, for if merely one square league of arable land were assigned to each 'pueblo,' there might be established in the valley as many 'pueblos' of Indians as there are in New Mexico; for although in the forementioned directions we gave it a certain extent, it is larger; for to the south, and in other directions, it has very extensive bays (*angulos*), and all of them containing good soil. Throughout the whole, there is good and abundant pasturage, and in parts there grow flax and hemp in such abundance that it appears as if it had been sown artificially; and the temperature here is pleasant, for after having suffered considerable from cold ever since we left the river San Buenaventura, we felt warm everywhere in the valley, both by night and by day. Besides these magnificent capabilities, there are found, in the mountains that surround it, plenty of wood for fuel and timber, and many sheltered spots, water, and pasturage adapted to the raising of large droves of cattle and horses. This is as regards the north, northeast, and southeast; to the south, and southwest, there are two other wide valleys, also full of abundant pastures, and with plenty of water; to one of these reaches the lake, and next to the latter there is a large piece of the valley strongly impregnated with saltpeter. The lake is six leagues wide by fifteen long; it runs to the northwest, and by a narrow outlet, as we were told, it communicates with other much larger lakes. This one of the Timpanogotzis abounds in every kind of good fish, geese, otters, and other amphibious animals, which we had no opportunity of seeing. On its shores dwell the aforementioned Indians, who live upon the abundant fish-supplies of the lake, whence the Sabuagana Gutas call them fish-eaters (*Cornepescados*). Besides this, they gather on the plains seeds of plants, and make a sort of gruel (*atole*) with them; although they add to this the hunting of hares, rabbits, and sage-hens (*gallinas*), of which there is a great abundance. There are also buffaloes not far to the eastward, but the fear of the Comanches prevents them from hunting them; their dwellings are a sort of huts, or 'jacalijos,' of osiers, of which they make also baskets, and other necessary utensils. Their dress manifests great poverty; the most decent which they wear is a coat or shirt (*sago*) of deerskin, and big moccasins (*botas*) of the same in winter; they have dresses made of hare and rabbit skins. They speak the Yuta language, but with a noticeable variation of accent, and even of some words. They are good featured, and mostly without beard. They are found inhabiting most parts of this Sierra to the southwest and northwest—a great many tribes of the same nation, language, and docile disposition as these lake Indians, out of whom might be formed a populous and extensive province.

"The names of the chiefs contained in the sena? above referred to, are, in their language, of the principal chief, Turunianchi; of the second, Cuitzapamichi; of the third, who is the same as our friend Silvestre, Panchucunquibran (which means the orator or speaker); the fourth, who is not a chief and is the brother of the principal chief, is called Pichuchi.

"The other lake with which this one communicates is, as they informed us, many leagues in extent, and its waters are noxious and extremely salt, so that the Timpanogotzis asserted to us that when any one rubbed a part of his body with it he would feel an itching sensation in the moistened part. On its borders, they told us, there dwelt a numerous and peaceable nation, called Paguampe, which, in our language, means throwers or slingers (*echizeros*), which nation speaks the Comanche language, and live upon herbs, drink at the springs and streams of good water that are found around the lake, and have their huts of 'sacate?' and earth (which must be their roofs). They are not considered enemies by the Timpanogotzis—so it was said—but ever since a certain time when they came together, and a man was killed, there has not been the same good fellowship as before. On this occasion the Timpanogotzis entered by the extreme point of the Sierra Blancha (which is the same as that where they are) by a route north quarter west from their country, and by this same route they say that the Cemanlos also make their entrances, which do not appear to be very frequent.*

"The Timpanogotzis call themselves thus after the lake, which they name Timpanogo, and this is a name peculiar to it—for the name or word by which they designate a lake is usually 'Pagariri.'"

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* The whole of this last phrase is very obscure, and, besides, I suspect that for *Cemanlos* should be read *Comanches*.—P. H.

Notes to the above description:

(*a*) Escalante's stated latitudes are not to be depended on; his observations must have been made with very rough instruments. His courses and distances, however, are remarkably accurate when compared with our maps.

(*b*) Escalante's courses appear to be magnetic. The variation at the present day is about 17° east.

(*c*) This was probably the Timpanogos River of the present day. The others have various names, such as Spanish Fork, Salt Creek, &c.—P. H.

PHILIP HARRY,
Bureau of Topographical Engineers, Washington, D. C.

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